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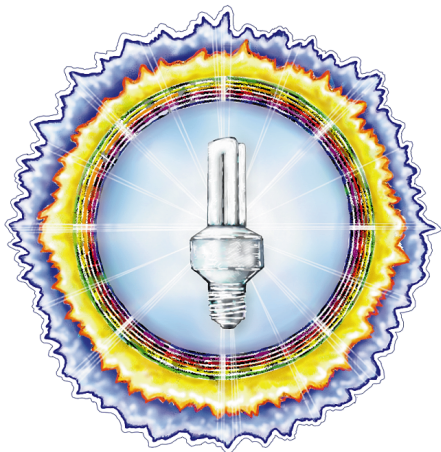
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August / September 1998

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Y2K

Over the last two months, everyone in the RE community has been deluged with questions about the potential Y2K problem. The essence of this potential problem is that many computer programs and some computers may not be able to handle the transition to the next millennium. I have received hundreds of bits of mail about this from readers. Their concerns range from RE equipment failure, utility failure, communications failure, banking failure, and transportation failure—all due to the inability of various computers to handle the dates of the new millennium.

We examined all the RE gear we could get our hands on. We could not find a single device with the potential Y2K problem. Most bits of RE gear don't know what the date is, even if the gear uses a microprocessor. No problems here. We checked the computers we use in our office—all Macs. No Y2K problems here. From what I hear, utilities, banks, phone companies, airlines, and other computer dependent industries are spending megabucks fixing their computer programs and hardware. Will they fix all the bugs? My guess is that they will get most of them. But still, I'm not planning on flying in an airliner on 1 January 2000....

I think that the main danger associated with Y2K is the public hysteria which could easily produce a self-fulfilling prophesy. If we all freak out and take our money out of the banks during December of 1999, then we probably will have worldwide economic problems. I also think that Big Media is playing this story for all it's worth—thus increasing public hysteria.

Here's my advice for those of you concerned about Y2K—install a renewable energy system. That way if society falls apart, then at least you will have electricity. If society doesn't fall apart, then at least you will have electricity.

Richard Perez for the Home Power Crew

Written on 3 July 1998 at Funky Mountain Institute (42°01'02"N • 122°23'19"W) using solar & wind power.



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 Mick Sagrillo
 Bob-O Schultze
 Terry Schuyler
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"Think about it..."

**"Tasty,
 but not hot."**

– Dave "the Scoville Kid"

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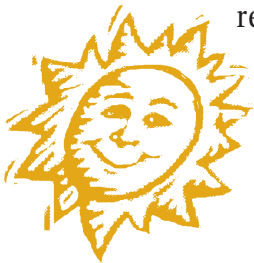
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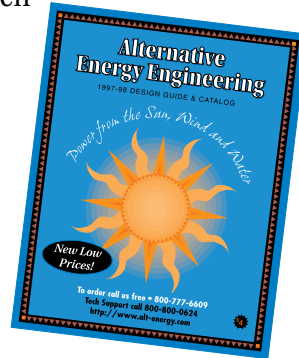


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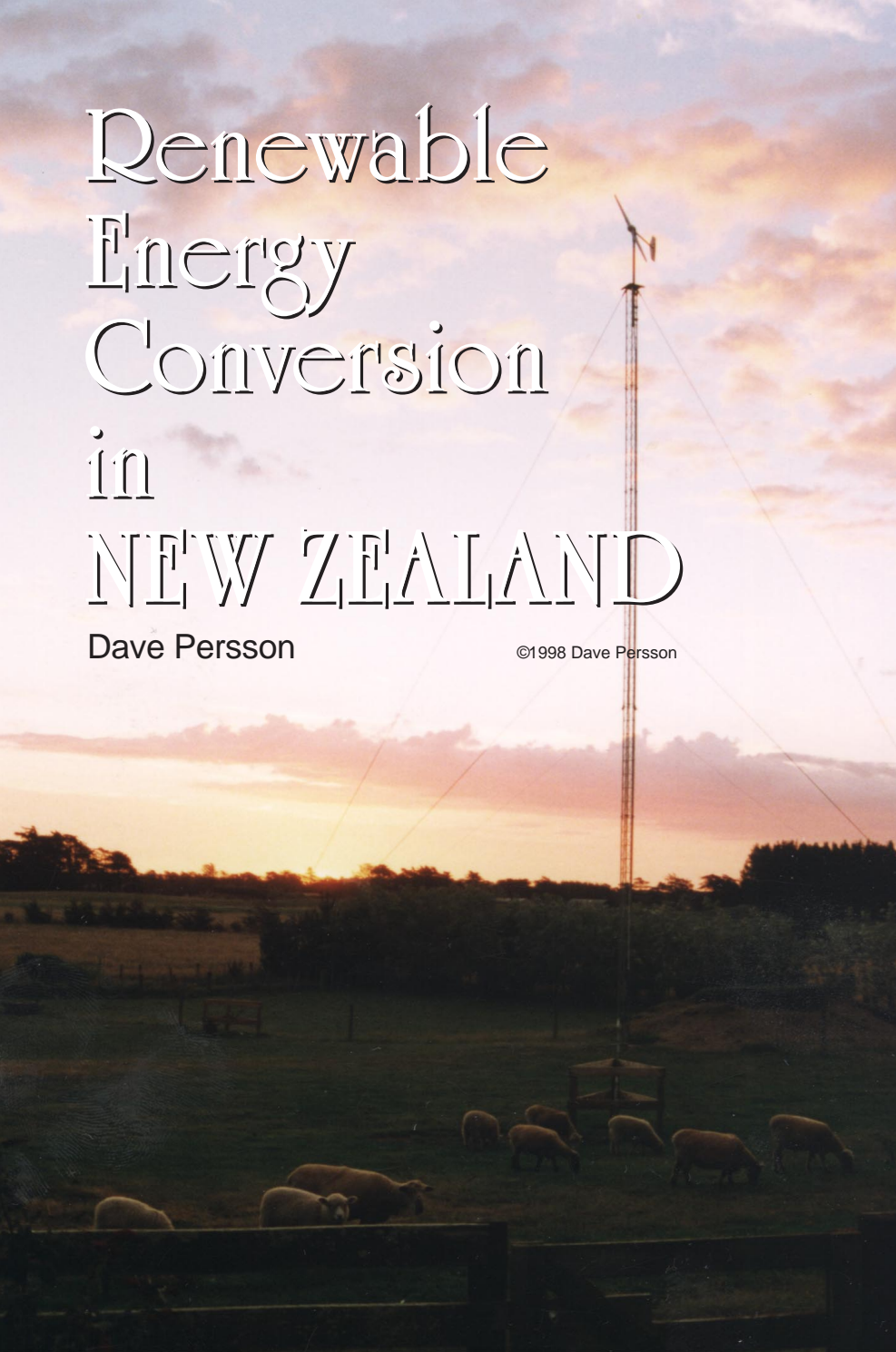
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Renewable Energy Conversion in NEW ZEALAND

Dave Persson

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Above: Sunset at Glen Oroua, the Soma 1000 wind genny on a 22.5 metre tower, and a few of the locals.

Renewable energy is fast becoming a common and cost effective option for New Zealanders with each passing year, especially in rural areas away from power lines. This article explores some of the available options in RE and details a rural New Zealand home with four occupants in the conversion from grid-connected electricity to RE sources.

Our goal is to demonstrate that renewable energy is available now and is not exclusive to people in remote locations away from power lines. This project began as a small-scale supplementary power system. It stands now as a complete replacement for all grid power. To make the system cost effective, tasks such as cooking and heating are performed using LPG and firewood. This system was initially profiled by Bill & Katcha Sanderson in *HP 49*.

The household is located on the Manawatu plains, at Glen Oroua, approximately 25 km west of Palmerston North. The site is considered to have fair wind and solar resources with approximately 2000 hours of sunshine each year. The average annual wind run is 333 km per day at 6 meters above ground level.

How it All Began

During the mid-70's, around the time of the first oil scarcity, I was lucky enough to be in a science class where a teacher introduced us to a solar electric panel. Using this panel, he powered an electric motor and light bulb. I was fascinated—electric power from sunshine! This was the beginning of my interest in RE.

In 1991, my employer, Telecom New Zealand Limited, published a disposals catalogue in which there were solar panels for sale. I made some inquiries and ended up buying six of these unused panels for the bargain price of \$75 each! They were Solarex LX137's, rated at 37.5 Watts.

As my wife Raewyn and I were due to start building a house in the spring, it was an ideal time to incorporate RE into the design. There were many factors to consider, but the hardest of all was figuring out where to start. I checked local libraries, bookshops, and electrical wholesalers, only to find

out that RE information was scarce. I decided to go it alone, and proceed with the installation as best I could.

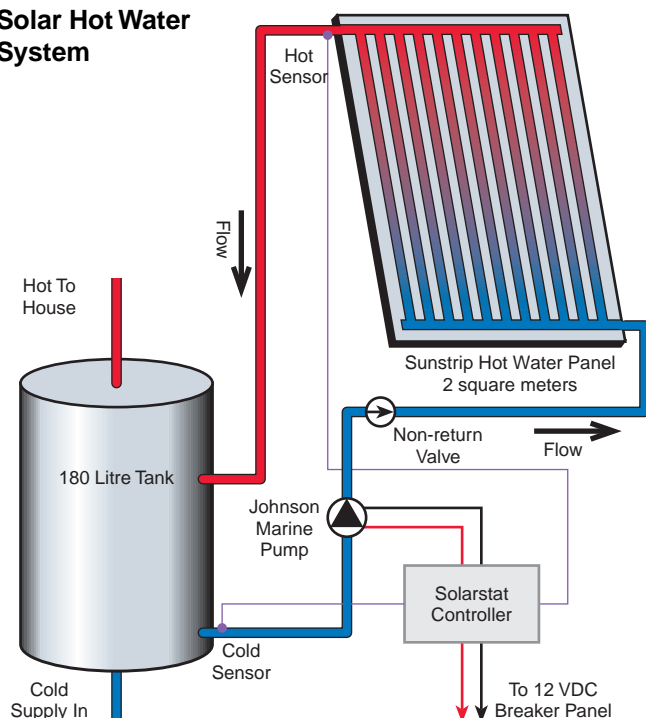
We improved aspects of the original house design. South facing windows were minimized or moved from the south side of the house to other walls. We modified the electrical wiring to include more lighting and hot points. I installed all of the wiring; it was then certified by an electrician and by an inspector. The toilet flusher was changed from single to dual flush for water conservation. The hot water cylinder was plumbed for both wood-fired wet back operation as well as solar hot water operation.

Hot Water System

The hot water cylinder holds 180 litres and is thermally rated as A-grade. In hindsight, this tank is too small, although we rarely run out of hot water. A 300 litre cylinder would be better suited to the solar hot water operation and to the demands of the household.

Active (pumped) circulation was chosen for the solar hot water system because there was no way to place the hot water cylinder above the collector for thermosyphoning. The additional costs for the active

Solar Hot Water System



Above: Author Dave Persson on the roof with six Solarex LX137 PV panels.

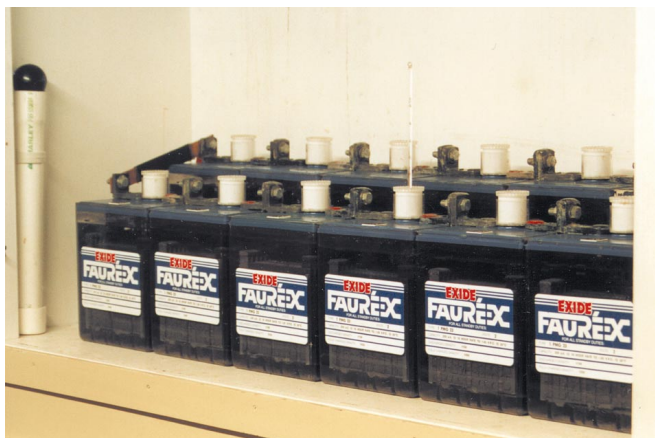
circulation included a pump, a temperature differential controller, a non-return valve to stop reverse thermosyphoning, and the power to run it.

During wintertime, when the panel temperature drops under 3°C, the controller switches on the pump to circulate water from the cylinder. With the fluid in circulation, the panel doesn't need a frost plug or drainage.

Because the solar pumping system was powered by 12 VDC, I spent considerable time finding and purchasing a heat rated Johnson marine pump, which cost me \$489. An alternative was to purchase a small inverter and 240 vac pump at a similar cost. The Sunstrip solar hot water panel was from Wellwind Energy of Wellington, imported from China. The area of the panel is 2 square metres and cost \$989.

To regulate the operation of the pump, we purchased a Solarstat temperature controller for \$220. It monitors panel and cylinder water temperature. When the panel water is 12°C hotter than in the bottom of the cylinder, the controller switches on the pump. The pump is turned off when it senses water less than 6°C warmer in the panel. Temperature sensors are located at the panel and at the bottom of the hot water cylinder. All pipes to and from the collector are insulated with 12.5 mm foam.

The solar system and our wind generator provide all of the hot water from October through April. May through September, a wet back fireplace supplements the wind/solar system.



Above: Thirty-six Exide lead-acid cells are wired for 24 Volts. A center tap provides for 12 VDC loads.

The wet back wood fireplace is heat rated at 16.5 kW. The heat exchanger is a single pass of 25 mm copper pipe through the back of the wood fire, rated at 1 kW. This is not enough surface area to heat 180 litres of cold water without a considerable time delay, but it works fine when the fire is burning continuously as it often does during the winter.

Electrical Wiring

When the house was wired for both DC and ac appliances, various draw wires were inserted in the walls for future use. The DC circuits supply power to light duty applications including lighting, stereo, solar hot water pump and controller, alarm clock, and radio/short-wave receiver.

The ac circuits supply power to the pressure pump, refrigeration, reticulated power points, lighting, and a small 1 kW rewired fan heater. Power was also initially supplied to a 16 kW domestic range, but this has now been replaced with an LPG cooker.

In More Detail

The 12 V sub-circuits feed from a distribution center in the garage using tough polythene sheath cable (TPS). The 25 mm twin TPS cable is 16.5 metres in length. From there, the circuits are terminated and redistributed via 2.5 mm and 6 mm cables to all of the DC loads. In the house distribution box, there are 5/10/15 Amp fuses on each live conductor of each sub-circuit.

The 240 vac circuits are wired as per the MEN (multiple earth, neutral) system used here in New Zealand. This means that the earth and neutral conductors are bonded together at the house meter box and at the transformer of the local power distribution company. Earth electrodes are inserted in the ground at these points to provide a low resistance path to earth should a fault develop on any appliance. The live phase

conductor circuit contains a fuse/circuit breaker that can blow causing the circuit to deactivate should a fault occur between the live and the neutral and/or earth conductors.

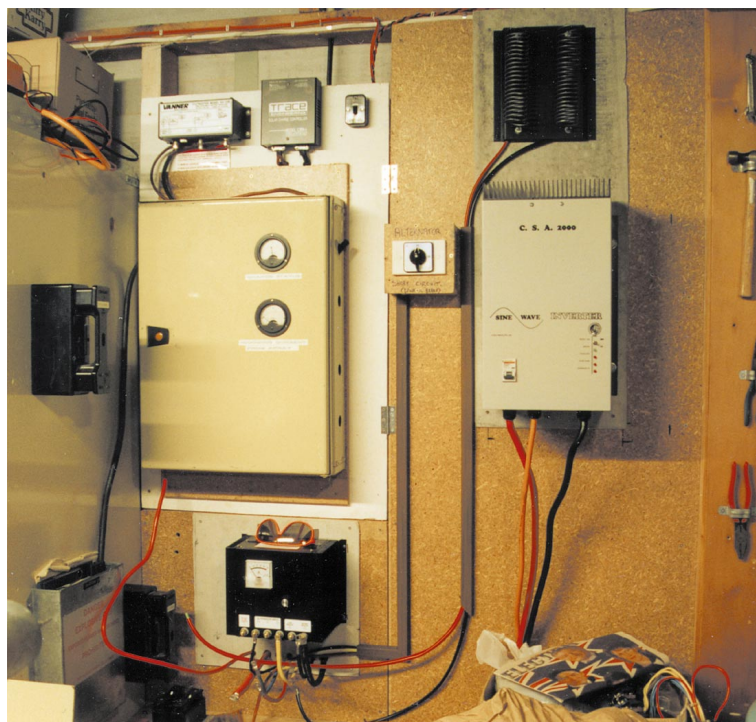
System Batteries

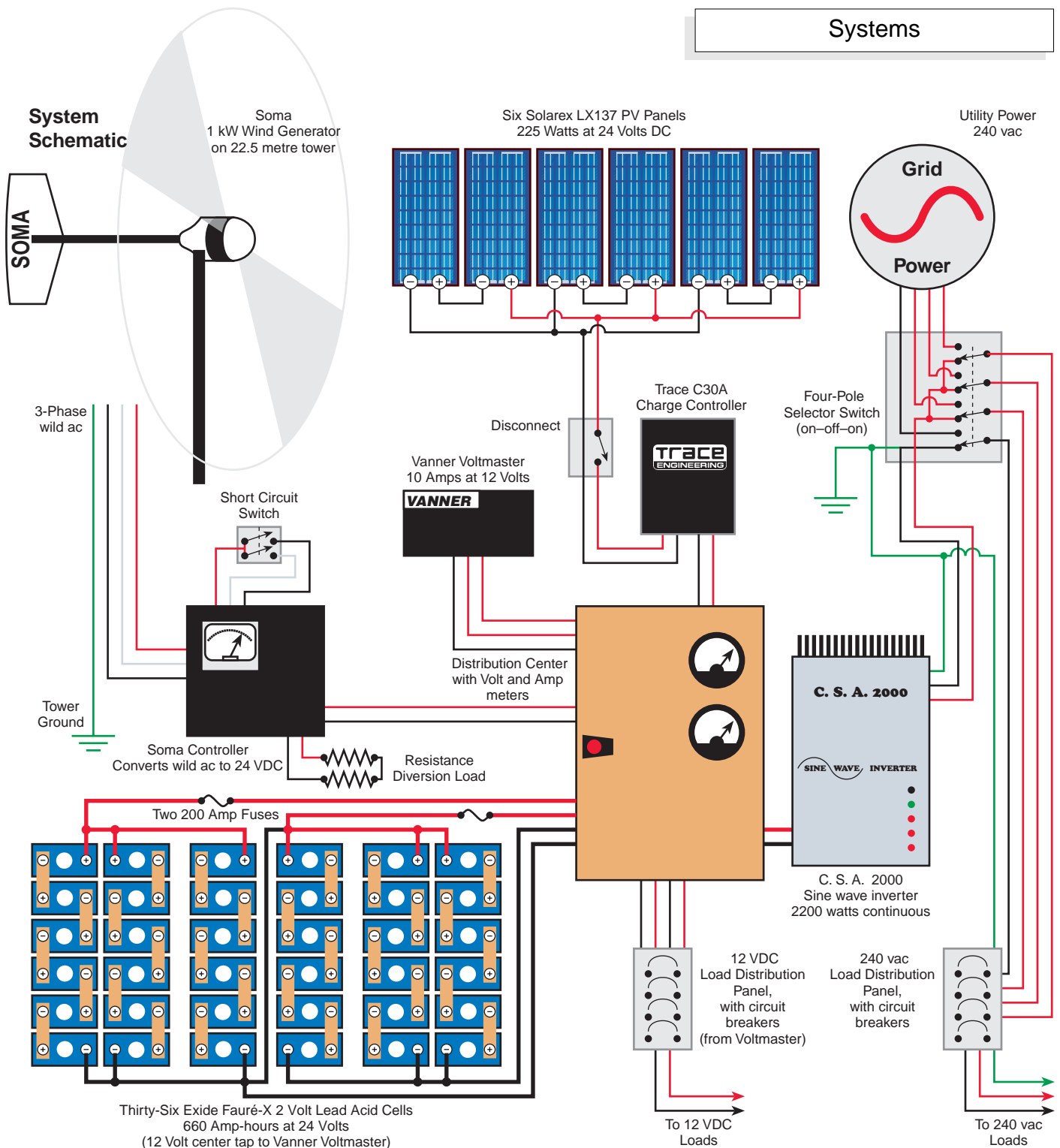
Initially, we used 6 V standby batteries, but we replaced these with 2 Volt, 220 A-h, Exide Fauré-X deep cycle batteries recovered from a decommissioned Telecom exchange. There are 36 of these cells providing 660 A-h of storage at 24 V. These seven-year-old batteries were purchased at scrap value from Telecom NZ LTD.

The batteries are housed in cabinets in the garage. There are 12 cells in each of three compartments. They are joined to the distribution center with 90 mm cable and solid copper bus bars. Petroleum jelly covers all exposed metal to prevent corrosion. Each compartment houses a hydrometer to measure battery state of charge and a thermometer (in one of the cells) to measure battery temperature.

The battery is never cycled beyond 50% of its nominal capacity and is visually inspected at least every six weeks. Pilot cell voltage and specific gravity readings are taken and recorded semi-annually. All cell voltages and specific gravity readings are measured and recorded at least yearly. Danger signs are attached to the outside of the battery box.

Below: Control center showing Vanner Voltmaster, Trace C30A, distribution box with metering, Soma controller, short circuit switch, diversion resistors, and C. S. A. inverter.





Inverter

In November of '95, we imported a C.S.A. inverter directly from Australia. This inverter has a rated output of 2200 watts continuous at 40°C. It has a surge of 6500 watts and is capable of powering 3000 watts for 10 minutes before needing to be de-rated. The purchase price of the inverter was \$3490 including shipping and government sales tax (GST). This pure sine wave inverter has performed flawlessly since

installation. The criteria for selecting this inverter included price, power output, reliability, ability to start fluorescent light bulbs, low standby current, low audible noise, and low radio frequency interference (RFI). An article in issue 49 of the Australian magazine *Soft Technology* (now known as *Renew*) assisted greatly with the purchase of this product. It gave a good comparison of all the models available with a similar output range.



Above: Anchor installation for tower guys. More concrete goes on top of wire reinforcing.

In most respects, this inverter passes with flying colours. I do, however, have some RFI on the DC power supply now. I will attempt to filter this with several thousand microfarads of capacitance on the DC supply to the problem appliances.

Solar Electric Panels

Power is supplied by the six Solarex panels, roof mounted on stainless steel bearers. The mounts are approximately 30 mm wide by 450 mm long and 3 mm thick. They have extra holes for seasonal adjustment of the panels. Each panel has four stainless steel angle braces that bolt to the bearers. The bolts act as hinges at the bottom of each panel. Maintenance of the panels is limited to a yearly visual inspection of the panels and washing them down as required.

The panels were initially wired in parallel to supply a nominal 12 V to the batteries with a summer peak current of 14 Amps for several hours. I have found that either the panels are underrated (2.67 Amps @ 14 V) or my ammeter is incorrect. These panels are producing

Below: Finished guy anchor ready for burial.



peak power more like 50 W panels, not like the 37.5 W quoted (3.5 Amps/panel).

To reduce power losses from the high current loads I expected from the inverter, the solar panels were rewired to supply 24 V. This also required rewiring of the battery and replacement of the charge controller.

Control Equipment

Initially, the charge controller was a BP solar 16 Amp two-stage controller. This controller had a boost charge followed by a float charge cycle. Before the solar panels were rewired, I replaced the BP model with a TRACE 30 Amp 12/24 V compatible C30A charge controller.

I thought that the TRACE controller would be the natural replacement for the BP model, but it does have disadvantages. First, it is a relay-controlled device, which can burn out in time. The BP is a solid state device using power transistors for switching. Second, the TRACE model has only single stage regulation, so you cannot boost charge then float charge your batteries. The third disadvantage is that the equalize function sold with this device defeats any voltage regulation. This means that you need to measure your battery voltage constantly to ensure that you don't damage your batteries. In spite of the additional current capability and the ability to run this device at either 12 or 24 V, I believe that a solid state device with two-stage regulation would be a better choice for the health of any lead acid battery.

24 V Load Problems

The 12 V loads were a problem when we converted from 12 to 24 V. Our options were either to power the loads from each half of the battery, to build a 24/12 V linear voltage regulators to power the 12 V loads, or to purchase a voltage equalizer. I decided to attempt to balance the 12 V loads and power them from each half of the 24 V battery.

Balancing the loads turned out to be a complete failure. No matter how hard I tried, a perfect balance could not be achieved. Loads were swapped, moved, and turned off. I still had the same problem; one battery would overcharge while the other would never fully charge. After much fiddling, we decided to buy a voltage equalizer.

With a voltage equalizer, all of the loads are on one half of the battery at any given time. The equalization device connects both halves of the battery bank. It transfers power from the unloaded half of the battery to the loaded half, or to the half with the lower voltage. The Vanner Voltmaster was imported directly from the USA at a considerable cost of \$500. It can transfer 10 Amps of current between battery halves continuously. 20 and 50 Amp models are available.

Pulse width modulation (fast switching on and off of power transistors) is used for current transfer. There is some radio interference from the device on the AM radio spectrum. The higher the load, the worse the interference.

The purchase of the Voltmaster had eliminated the battery charging problems until it failed in service recently. I have repaired it and restored the battery into balanced service again.

DC/ac Loads

The DC circuits are primarily for lighting. Tungsten halogen bulbs provide good light to service areas and 25 W incandescent bulbs are used in the bedroom as reading lights. Replacement of these bulbs with fluorescent lighting is not suitable because they get turned on and off a lot and are not often used for extended periods of time. All other DC loads are high efficiency.

All lighting in the higher use areas of the household such as the dining room, hall, lounge, and family rooms was changed to high efficiency PLC electronic compact fluorescents.

The ac loads have been examined in detail. We implemented a replacement program to eliminate inefficient loads. Even before we began, phantom loads were identified and eliminated wherever possible. This included the TV, video, microwave oven, washing machine, and computer printer. The problem appliances all have switches on the wall socket and are simply switched off when not required.

Appliance Efficiency

Once we had the phantom loads under control, we focused on the household appliances. The house was using 8 kWh of electricity every day, so usage needed to be reduced if RE was to become a realistic and not too costly option.

After reading magazines such as Home Power and Soft Technology, I found that the water heater, electric stove, clothes dryer, dishwasher, fridges, freezers, and older washing machines were large users of electricity. Since we didn't have an old washer, dryer, or dishwasher, we decided to examine the refrigeration and cooking appliances.

We replaced the electric stove with gas. My brother-in-law worked for a gas wholesaler/retailer and we purchased a cooker at cost through him. The selection criteria included no phantom load, use of minimal or no electricity, and affordability.

Eventually we purchased a Vulcan Solitaire cooker, LPG regulator, and gas bottles. They were installed by a qualified gas fitter for a certified installation, required



Above: Tower base during concrete pour.

for any insurance claim. Two LPG bottles of 18 kg capacity supply the stove and are automatically switched by an auto change regulator with an indicator to demonstrate when a bottle is empty. Approximately once every five months, one of the bottles needs filling at a cost of \$25.

Below: Caelum inspects the finished tower base.



The gas bottles are located outside as per regulation. All cooking is performed on the cooker, except for a small amount of microwave use. The cost to run this system is approximately \$1.50 per week, plus the cost of required cylinder checks once every ten years. The gas stove and LPG system performance have exceeded all expectations. The capital cost of the LPG system and cooker was \$2300 installed.

The stove replacement lowered our daily electricity use about 1.5 to 2 kWh. This was not as much as expected, but the 8 kWh use per day had dropped to 6.5 kWh. At least it was a reduction.

Below: Dave Persson and Darryl Greer bolt tower sections together with the help of a crane.
Kids watch from a safe distance.



Refrigerator Search

The next appliance to be considered was the refrigerator. At the time, we had a 20-year-old Leonard model with no freezer. The insulation thickness was about 25 mm, and I suspected that it might use a fair amount of electricity. I had no way of measuring the amount of energy used by the fridge, unless I unplugged it and measured the savings on the kWh meter for a few days. Regardless of energy use, the decision was made to replace it.

First, we collected brochures for all of the refrigerators and freezers available in New Zealand. Next, we checked the energy efficiency rating of the appliances (number of stars on the front door). There appeared to be a large variation in energy efficiency between similar sized, and in some cases, almost identical appliances. Fisher & Paykel, Simpson, and Kelvinator refrigerators were sampled. Even the most energy efficient model was nowhere near as efficient as the Sun Frost refrigerators from America. The Sun Frost is at least five times as energy efficient as any of the New Zealand brands sampled.

The shape, size, and cost of the Sun Frost were problems. Unfortunately, they were not sized for the space we needed to fill, as they were square rather than rectangular. They were also four times the price for the same capacity. Other options were dismissed, such as purchasing a gas refrigerator or retrofitting a vertical freezer with a high efficiency compressor and altering the thermostat so that it would behave like a fridge.

Eventually, we located a refrigerator that fit our criteria. We chose a low energy Gram brand model 202LE (202 litres) imported from Denmark. It is powered by 240 vac and is more efficient than similar sized fridges available in New Zealand that have energy uses in the 1.3 - 1.8 kWh per day range. It has performed flawlessly since early 1995.

Probably the most astounding thing was the immediate effect on our daily power usage, which dropped from 6.5 kWh to an average of 4.5 kWh. The only drawback of the 202LE was a slight reduction in storage capacity. Even though the exterior dimensions are virtually identical, the interior is slightly smaller because of a thicker insulation of 75 mm. The interior is well laid out with many shelves and plastic containers. The fridge was purchased from Independent Power, Ltd. of Auckland for \$1690 including GST. It was almost twice the price of a conventional fridge of similar dimensions.

In July 1996, the same criteria were applied to find a replacement freezer, with similar results. While New Zealand and Australian freezers seemed relatively efficient, the imported Danish models were vastly

superior. We purchased a super low energy Elcold model SLE. The capacity of this freezer is 335 litres, and cost \$1750. Energy consumption is approximately 660 Wh per day, compared to the 1.5 to 2 kWh for commercially available NZ models. The insulation in the freezer walls, at 100 mm, is considerably thicker than the conventional 50 mm. In addition, the SLE uses a smaller, more efficient compressor. The new freezer is about one-third larger than our older model, but we still save 1.5 kWh per day.

Other Energy Notes

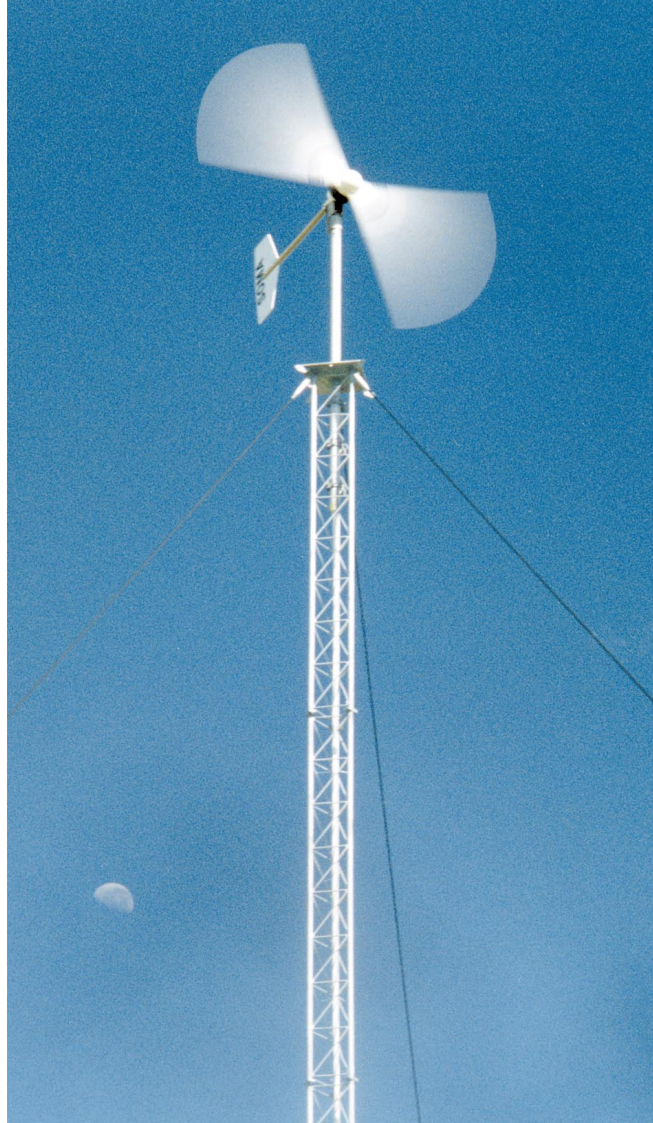
Our water pump is rated at 1/2 hp. The pressure tank draw-off was replaced and enlarged to 48 liters. The larger volume reduces the frequency of the pump to switch on. This in turn reduces the load on the inverter, by decreasing both the large number of on/off cycles and the resulting high current surges. Replacement also maintained a more even water pressure to the household.

No further replacement of appliances will take place for some time, since we've taken care of the major energy hogs of the household. The average energy usage is now around 3 kWh per day. While the cost of energy efficient appliances is higher than standard models, going this route costs considerably less than the price of extra solar panels and/or a wind generator. The result is a net savings in both capital cost and in battery storage area.

Choosing a Wind Generator

A wind generator completes the installation and was selected for cut-in wind speed, rated output, wind speed at rated output, visual aesthetics, over-speed control features, price, local serviceability, reputation, and performance under local wind conditions. Machines producing between 500 to 2000 watts were investigated, including the Bergey 850 and 1500, Northwind HR1 and HR3, Windseeker 500, Wind Baron 750, Soma 1000, Whisper 1000, and Westwind 1800.

Power curve comparisons were graphed at various wind speeds up to 14 metres per second using the manufacturers' power curve data for each turbine. Some machines were dismissed almost immediately due to their high cost (Northwind HR1 and 3, and the Westwind 1800). Others appeared cost effective, but were dismissed as being unwise investments. The Wind Baron's over-speed control, though simple, appeared crude and seemed prone to allow the machine to vibrate in gusty wind conditions. The Whisper 1000 was dismissed, as I knew of two local instances where the blades had sheared off within a short period. The Windseeker 500 would not provide enough power for our needs. This left the Bergey 850 or 1500, and the Soma 1000.



Above: The Soma 1000 at work.

The Bergey wind turbines have excellent reputations. The cost for the Bergey 850 was comparable with the Soma 1000 if the Bergey was imported from the USA. The Bergey 1500 was approximately twice the price of the other machines. I favored the Bergey 1500 on looks and reputation, but the dollar per Watt cost was higher.

In a power curve comparison, the Bergey 850 turned out to be a "Bergey 550" at a wind speed of 10 meters per second (m/s), which was the rated wind speed for the Soma 1000. In comparison, the Bergey 1500 seemed a "Bergey 1200" at 10 m/s. Next, I gathered local wind speed from NZ Met service information data and corrected this to the hub height intended for the turbine. Using this data and the manufacturers' power curves, I produced a spreadsheet of the power output of the two turbines under local wind conditions.

Soma 1000

We figured out that the Soma 1000 would produce more power in our expected wind conditions than the Bergey. We decided to purchase the locally manufactured Soma 1000, as they had a good reputation. The cost was \$4200 including the controls.

The Soma is mounted on a re-galvanized, decommissioned, 22.5 metre Telecom mast. The tower is guyed at 9, 12, and 21 metres. It has seven sections, which bolt together. The erection was performed in two separate operations. Using a farm tractor, the first four sections comprising 12 metres of the tower were set up first. After that, we used a crane to install the top three sections and wind generator.

The tower has been earthed for lightning protection. The resistance of this earth is low (8 Ω) and was achieved by inserting three solid copper rods 3 metres in length into the ground at 3-metre intervals. We linked the rods and tower together with 35 mm cable.

A customized adapter and mounting plate accommodate the wind generator and mounting pipe at the top of the tower. From the Soma 1000, 16 mm three-core cable extends down the tower, where it is joined to more cable. This continues through buried duct 61 metres to the PWM controller in the garage next to the batteries. At the controller, the three-phase variable frequency ac current is converted to DC. It then runs to the distribution center and batteries. The current is supplied via a single-phase 50 mm cable. The controller dumps power into a resistive load or hot water element when the batteries are full.

Stay wires for the tower are attached to anchors set in reinforced concrete 1 m by 1 m by 0.4 m deep, buried 1 m underground. A fence surrounds each anchor to protect it from farm animals. The tower stands on three 450 mm bolts set in a reinforced concrete foundation 0.6 m by 0.6 m wide by 1.2 m deep.

Maintenance for the wind generator includes a yearly inspection of the tower for rust, loose nuts and bolts, cracks, etc. At this time, we also inspect the anchors, associated hardware, and wind turbine. On the turbine, we also lubricate the governor. Every six months, we inspect the wind turbine itself (climb that tower!).

System Performance

It has been one year since we have completely commissioned the system. In most aspects, things are working well. Aside from the voltage equalizer, we have experienced problems from reduced solar and wind levels during the winter. We had to switch to grid power two out of seven days during June and July, but that was anticipated to some extent.

The Soma wind generator failed after three months in service. A call to the manufacturer pinpointed the problem. A wire between the alternator and the slip rings had broken because the wire was too short for the tilt back. The machine was down for a period of six weeks while I redesigned and reinstalled the wiring between these two points. Because I purchased the

Persson System Loads

#	Load (240 volt)	Run Watts	Hrs / day	Total W-hrs
1	Freezer	100	6.0	600
1	Washing machine	1000	0.5	500
1	Refrigerator	80	6.0	480
1	T.V	80	3.0	240
1	Water pump	320	0.7	224
1	Fanheater (winter)	1000	0.2	200
8	Incandescent light @ 60 W	480	0.3	144
1	Computer	200	0.5	100
1	Toaster	1000	0.1	100
3	Fluorescent light @ 15 W	45	2.0	90
1	Iron	900	0.1	45
	Kitchen appliances (avg.)	400	0.1	40
1	Breadmaker	380	0.1	38
1	Video	34	1.0	34
1	Sewing machine	70	0.3	21
1	Overlocker	99	0.2	20
1	Fluorescent light	25	0.5	13
1	Incandescent light	40	0.2	8
1	Fluorescent light	9	0.5	5

Total 240 volt loads 2901

Load (12 Volt)

1	Solar hot water pump	25	4.0	100
2	Halogen lights @ 20 w	40	2.0	80
1	Stereo	30	2.0	60
3	Incandescent light @ 25 w	75	0.7	53
1	Halogen light	50	0.5	25
1	Alarm radio	9	1.5	14

Total 12 Volt loads 331

Total loads 3232

machine a full year before installing it, I could not claim it under warrantee (one-year: beware!). Most of the time, the tilt back mechanism is fine, but when it gets really windy (20+ m/s) the machine tilts all the way back and then the whole machine starts to rotate around the top of the tower! To avoid self-destruction of the tower and turbine in high wind, we electrically brake the turbine. On a more positive note, we haven't used any grid or supplementary power for six months!

Satisfaction and Independence

This project is nearing completion after seven years of work. All that remains is to disconnect from the grid. In most cases, the results have been rewarding, although the cost of pursuing such an option is not cheap. I see this project as a hobby and comparable to that of an

Persson System Costs

Item	Cost	%
Soma 1000 wind gen & controls	\$4,200	24.0%
C.S.A. Inverter	\$3,490	19.9%
LPG cooker & accessories	\$2,300	13.1%
Elcold freezer	\$1,750	10.0%
Gram refridgerator	\$1,690	9.7%
Solar hot water panel	\$989	5.6%
Water system pressure tank	\$560	3.2%
Voltmaster battery equaliser	\$500	2.9%
Tower, regalvanising, anchors, etc.	\$500	2.9%
Johnson marine pump	\$489	2.8%
Solarex LX137 panels	\$450	2.6%
Solar pump controller	\$220	1.3%
Wet back heat exchanger	\$120	0.7%
Batteries	\$108	0.6%
Plumbing accessories	\$90	0.5%
Wetback & solar H2O cylinder	\$50	0.3%

Total \$17,506

automobile enthusiast always attempting to improve a car for more power or higher efficiency.

The economics behind the project were not the major consideration when it first began. Rather, it has been the satisfaction that comes from the feeling of independence and the drive for self-determination. "Why should I need to purchase my electricity from the power company?" is an important question that we need to ask ourselves. When considering the feasibility of such a move, one could argue that the replacement cost of the fridge and freezer be removed from the equation because they were likely to be replaced anyway (albeit with less efficient units at half the cost).

This article, as first suggested, is intended for those contemplating using either renewable energy by itself, or in conjunction with power from the grid. I hope that it motivates people to use RE on a local basis rather than solely relying on the power company for energy needs. RE is here and available now. Let's use it!

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BED & BREAKFAST: SOLAR MEDITERRANEAN STYLE

Kay & Mike Pierson

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P Pierson's Country Place is a 6,500 square foot Mediterranean style steel framed bed and breakfast. It is located in Riverside County, California just minutes from the vineyards of Temecula and the mountains towering above Hemet. Our home is the culmination of over seven years of planning and construction. We had this dream and vision of what the home and surrounding property would look like, but there are many decisions and compromises between a dream and reality.

Planning Our Home

The planning began with utilizing five acres of land that had been retained from a larger parcel. We purchased it in 1977 as an investment, and then subdivided it. The property wasn't the ideal spot, but we owned it and it had potential. 'The land', as we referred to it for many years, is located near a small town called Homeland. We are in the inland valleys of Riverside County, just eighty miles southeast of Los Angeles and sixty-five miles northeast of San Diego. The summer temperatures are hot,

reaching up to the low 100's, while the winter temperatures occasionally get down to the low 20's. The location is far enough inland so that the coastline fog and haze is not a significant factor in the weather conditions.

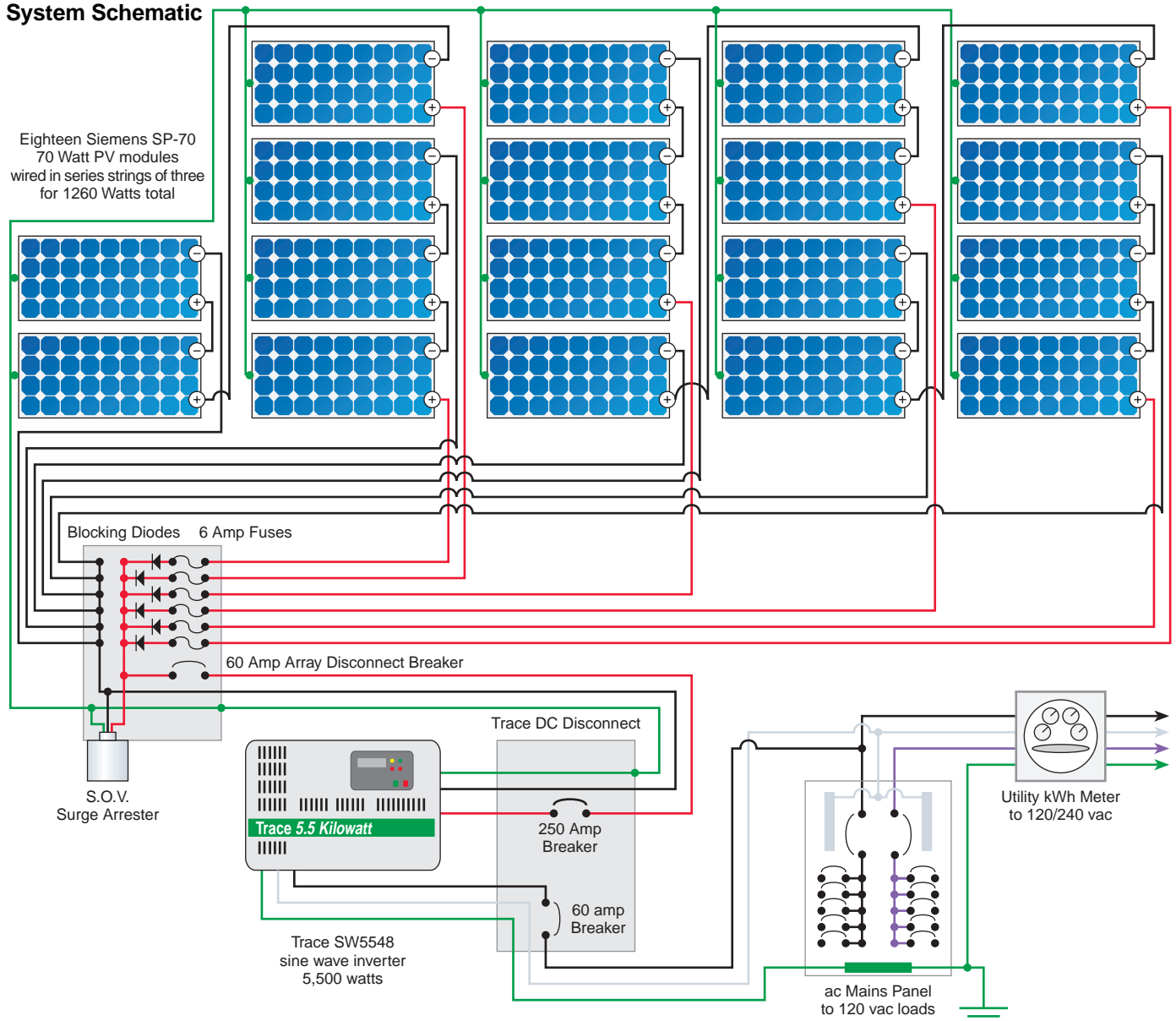
The Water Project

Providing water to the property was our first major project. Many of the neighbors utilized private wells. As these wells were going dry, we decided to pursue a different option. We helped to organize a request to bring Eastern Municipal Water District service up Pierson Road. Eventually, three neighbors joined the effort and we finally had running water to the property.

Below: The main sitting room of the Pierson's bed & breakfast.



System Schematic



The five acres were graded, resulting in two plots. The higher one was a two-acre plot for the house site. Once we got the water installed to this site, we started planting one and five gallon trees. The only shade on the five acres were two silver oaks that we had planted when we first subdivided the property in 1977. Since then, we've planted over three hundred trees to create the park-like setting of our dreams. Watering them all is still a major expense but we love the shade and greenery. It's just another compromise that we've made to achieve our dream house.

Using PV

We wanted to effectively develop a method for cooling and heating the home without compromising our dream. Mike had a Master's degree in technology management and had written his thesis on the use of PV technology.

He visited Japan, Germany, France and Holland to research the idea for his project. Naturally, one of our methods in meeting our challenge was to set up PV panels with a large southern facing roof area.

Mike even wrote to Texas Instruments and Southern California Edison, volunteering our home as an experimental site for their new roofing tiles. These tiles incorporate the PV cells into the roofing material and are quite flexible. The companies replied, and sent a receptive letter indicating that the technology was not yet ready for use on a home. However, in 1991, Mike had seen it in use on small projects in Japan. His thesis had predicted that the commercial use of PV cells would be readily available throughout the world by 1995. The technology transfer had certainly not happened at his projected rate within the United States.

Grid Intertie Difficulties

We also contacted Southern California Edison about setting up the system so that we could sell any excess electricity produced by our panels to them. It is no wonder that this grid intertie technique is not utilized more frequently by new homebuilders. It took sixteen months, three different people within Edison's contract organization and even a change in the California State law before we had a contract.

Originally, Edison proposed to buy the electricity from us wholesale and sell it to us at retail prices. This would have required us to set up two meters: one for the electricity we would sell to them, and another one for the electricity we would buy from the grid. The change in state law forced them to sell to us at the same price as they pay us for any excess we produce. It simplified the accounting requirements and enabled us to use a single meter. It gives us a great amount of pleasure to watch it turn backwards during the daylight hours, and know we'll still have service as required after the sun goes down.

PV System

Our electrical loads include interior lighting, appliances, dishwashers, stoves, garbage disposal, whirlpool tub, trash compactor, space heating and cooling.

Below: Trace SW5548 and DC disconnect.



Above: The eighteen Siemens SP70s on special brackets for tile roofs.

Our original plans included forty-five 95 Watt panels, installation of the infrastructure wiring and converter. We compromised by reducing the number of panels actually installed. We planned to phase the others in over time. This was a purely financial decision, as the other aspects of the house took up the capital originally reserved for the forty-five panels.

For six months, we worked closely with Mark Weidhaas at Alternative Solar Products, Inc. of Temecula. Mark was our local PV systems integrator who provided the supply of equipment and system design. Their staff offered assistance in sizing, schematics, and training to the C10 contractor prior to installation. Their experience with various manufacturers allowed us to choose the highest quality components available.

The total system cost including installation was approximately \$15,000. The components include the following:

- Eighteen Siemens SP-70 Watt solar modules
- Trace SW 5548 PV 5.5 kW line tie inverter
- Trace DC Disconnect
- 60 amp array combiner box with lightning protection and 60-amp breaker
- Wiring harness
- Array wiring and conduit
- Five Direct Power four-module racks and sixty Tile Tracks roof mounts

PV Specifics

To mount the PV modules, we used Tile Tracks, which are manufactured by Professional Solar Products. This is a unique new mounting system which allows

standard mounts to be offset on tile roofs without damaging tiles or compromising structural integrity. Additional tile tracks were installed to allow for expansion of the system at a later date.

Every three modules were wired in series to the array combiner box with separate fuses for each leg using #10 UV-rated TC cable. The cable connects the combiner box to the Trace DC disconnect, which is wired to the Trace SW5548 PV line tie inverter. From the inverter to the grid, the ac runs are also fuse protected through the DC disconnect box. System output is 1.26 kW per hour. The annual average total energy production is 7 kWh per day.

Insulation, Walls, & Roofing

Installing PV electricity was not the only way we tried to mitigate the heating and cooling concerns. From the interior, the exterior walls were composed of 5/8" drywall, 6" walls, 1" shear panels, and multiple layers of stucco. Inside the wall, we stuffed R21 rated insulation. We even did this on our attached 25'x50' four-car garage, since it shares a common roof structure and opens directly into the house. We insulated each interior wall with R11 to maintain temperature and noise control. All of the ceiling areas were filled with R30. A minimum of 3' roof overhangs, completely covered on the underside with stucco, helps to prevent the sun from directly shining on the house during the hot summer mid-day.

Our roof was covered with 1" CDX plywood, 30 lb paper, and red Mediterranean tile. We recognized that the tile was not as heat efficient as other roofing materials and is certainly more difficult for installing solar panels. However, this area is frequently beset with raging hillside fires and we wanted a fire-resistant exterior. Most importantly, the tile look was part of our dream.

We set up three zones so we can maintain the temperatures appropriately in different areas of the house. We installed ceiling fans in every room to help keep the airflow moving and mixed. We also placed three heat sensitive vent fans to pull the hot air out of the attic areas. These fans are set to run at 95° F.

Windows and Doors

Our home site is about five hundred feet above the valley floor and offers great western views of the sunsets and valley town lights. We wanted to take advantage of those views and planned large covered patio areas on the southwestern and western sides of the house.

All of the walls facing West have maximum use of windows, with the great room having four 8x8' sliding glass doors. All together there are 66 windows and

sliding glass doors. We used the vinyl double paned type to help keep the maintenance low and provide as much insulation as possible.

We ordered storm doors, not usually found in California, to insulate and protect the main entry areas. These doors have a double seal to protect against the wind. We also installed steel insulated exterior doors to help reduce heat loss in the winter months.

Flooring

The interior flooring decision was one that worked great in the summer, but not in the winter. Due to the unusually large concrete slab, the Italian tile in the majority of the house tends to keep the same temperature as the ground underneath it. During the summer months, it keeps the floor cool at around 55-60 degrees, unless it is directly heated through one of the windows. During the winter months, that cool flooring isn't really what we had in mind. During this time of the year, we use throw rugs to reduce the effect. Our best-laid plans still lead us to a compromise.

Come and Visit

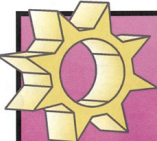
The original plans for our bed & breakfast home were based upon Mike's retirement from an aerospace firm at 55. We would sit on the porches in our rocking chairs, petting our three dogs, listening to the birds singing and watching the sunsets. Kay is an ex-schoolteacher and counselor, with a Master's degree and three credentials, and has always had multiple sideline jobs during our 32-year marriage. Our son Todd always commented that we would never be happy sitting and rocking. Along the way, we came to the same conclusion. We didn't really want to sit and rock (we never have and didn't see it in our future). We are very people oriented and love to entertain. As a bed & breakfast place, what better way to share our dream home, keep busy, and meet interesting people. Come and visit!

Access

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REMOTE POWER & AMATEUR RADIO

A Story of Home-Powered Communications

Peter Talbot

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Above: Peter's 80 meter short wave (on left), PV panel, and marine VHF (on right).

A recent issue of Home Power contained an article about the combination of amateur radio and solar power as a great example of a synergetic blend of technologies. Here's a tale of such a union.

The Need for Power

It all started back in 1979, when my good friend Gordon bothered me enough into studying for my ham radio license. At that time, I had a unique job working in the remote wilds of British Columbia as a ranger at a marine park. I was far from any of the everyday conveniences that we usually take for granted. This was an ideal spot for an independent electrical source and wireless communication, if ever there was one!

So there I was, staying up late at night studying the theory book by candle light and wondering why we still had to know all about vacuum tubes. In the back of my mind was the consuming question: how was I going to power a radio transmitter and the other electrical loads that I could use?

I soon got my license, and before long I fired up my first old radio transmitter, gasping at the 10 Amps it drew from the 12 Volt battery that I had pulled from my boat.

It soon became obvious that there was a need for a steady supply of DC power to run all of the loads that I was adding. As a kid, I made a crude pelton wheel out of a tin can and pieces of Meccano (like an Erector Set) and used the garden hose to power it. The wheel was then coupled to a bicycle generator. I could run a few lights and an AM radio with it. I thought to myself, "Well, why not do the same thing here, but on a larger scale?"

Amateur Micro-Hydro

There was a stream, which flowed over a sloping waterfall close by. It looked like it could spin some form of wheel and do useful work. Knowing next to nothing at the time about the design of micro-hydro plants, I set to work with a few lengths of 3" plastic pipe, plywood, and some glue. Before long, I had a 14" diameter wheel mounted on a 1" steel shaft, and an 80' pipeline. The wheel was crude, to say the least. It was more like a paddle wheel than a skillfully crafted pelton runner. Nevertheless, when I aimed a 1" jet of water at it with 30' of head, the wheel took off!

I scrounged an old Delco alternator and coupled it with a fan belt to a 10" pulley on the wheel. I turned on the water and was ecstatic when a meter showed that eight Amps were being produced from this simple setup! I ran the output and a length of bare #8 copper wire through the trees 200' to the cabin. This kept the battery fully charged all season, and I had plenty of power for

lighting and the radio transmitter. On a quiet night when the stream was low, I could hear the soft whirring of that old wheel and the muffled cracks as air under pressure shot out of the nozzle. That first setup was a classic, and thrilled me more than anything has since!

Soon, I was able to talk halfway around the world from my small cabin in the woods. I was amazed at how the power of falling water could spin a simple turbine to produce mechanical energy that in turn was being converted into electricity. In the trees overhead, a simple wire antenna was radiating high-frequency radio waves that could be picked up thousands of miles away. I logged conversations to Japan, Australia, and even had a contact to Russia.

Practical Aspects

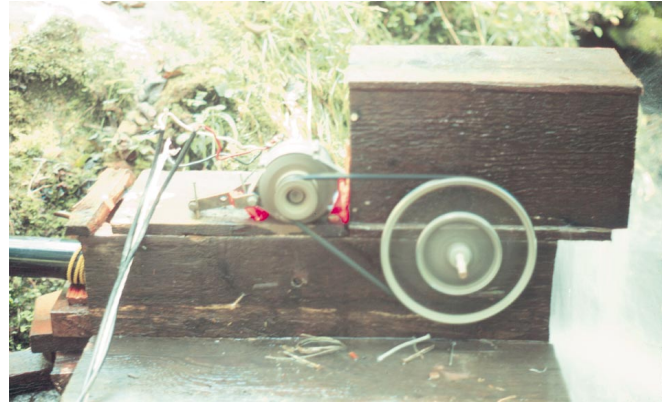
The water-powered ham radio station was also useful in other aspects. I could pass on information for boaters who were making their way up this part of the coast. I did this by contacting other ham operators who would then pass traffic on to family or friends via telephone.

From a safety standpoint, the hydro plant allowed me to call out for help should the need arise. This situation was not long in coming. A man had climbed a steep waterfall and had fallen with rather bad consequences, requiring air evacuation and police assistance. The fastest way to get help was to fire up the transmitter, break in on a local conversation, and have a phone patch made to the authorities. Within an hour, a plane was tied up at the dock.

Solar Adventures

I was off on a solo kayak trip 400 miles from home. The ultimate destination was a place called Brooks Peninsula on the western coast of Vancouver Island. Brooks is just about as far as one can go on the island, as it's a three-day paddle from the roads end. It's the kind of place that demands decent weather and keeping your wits about you. One can never guarantee that there will be other people in such a remote location, so I consider the ham gear and a solar panel essential. I probably wouldn't go to such a place if I didn't have it and couldn't rely on it working when required.

This time, I had a small low power short wave radio transmitter on board. I designed and built the transmitter with reliability, small size, and light weight in mind for use on backpacking trips and other adventures. The charging source for both the miniature ham radio and a VHF marine radio is a piece of an amorphous solar panel that I cut from a larger broken panel. I mounted the 4" by 12" strip on 1" thick waterproof foam and then encased it in an aluminum shell with a Plexiglas window. The result is a rugged,



Above: The original home-built hydro powers the 10 Amp radio transmitter.

fully seawater-proof and buoyant solar charger. I fasten it on the bow of my kayak so that it gets maximum exposure to the sun. It outputs 14 Volts open circuit and 75 mA short circuit. The four NiCd cells see about 50 mA in average conditions, which is just about right. With the solar charger hooked up, I have never been without the use of the radios even after a long trip.

With the Brooks Peninsula destination in mind, it takes all day to reach the launch point. Much of the afternoon is spent driving over rough logging roads. If I've planned well, I can get the kayak loaded and be under way within half an hour. The concern then turns to navigation along the rocky coastline, watching for bad weather, and finding a suitable site to set up camp. Often this takes place in the gathering gloom, illuminated by a small halogen searchlight. A gel cell powers the light, which is solar charged, of course!

When I arrived on the island, I found the perfect place to camp—a small, sheltered lagoon with a smooth sandy beach surrounded by dense forest. I arrived early enough to get all the gear set up. Soon, I had the BC Public Service Net tuned in, and was receiving signals from all over the West Coast.

I generally try to make contact each night on the Net to let the folks back home know of my progress and outline my plans for the next day. It's a comforting thought knowing that if anything went drastically wrong, people would know where I was. This in no way detracts from the wilderness experience. I enjoy both aspects of the adventure and it makes good sense to play it safe in these remote locations.

Ham Radio to the Rescue

While collecting driftwood and attending to matters at hand, I was so preoccupied that I scarcely noticed the approaching water. At this time of year, the tides peak in the evening and rise right to the top of the beach where I was camped. I heard a sputtering sound, and saw a

cloud of steam as my campfire floated away—the tent was about to get flooded! I grabbed the ham rig and fired it up. Earlier, I had heard another marine mobile check into the BC Net. I figured I'd try to raise him to see if he had a tide table. If it was close to high slack, I just might make it without pulling camp. The word came back from a sailboat 150 miles south of my position that the tide was just about to turn at Brooks, so I anxiously waited. Sure enough, within five minutes the water started to recede!

For the next few days, I passed by some of the finest coastal scenery on the planet, and encountered no one else. The pleasure of working with renewable energy and amateur radio comes alive on adventures like this one. The blend of technologies is perfectly suited to these sojourns into the wilderness.

Access

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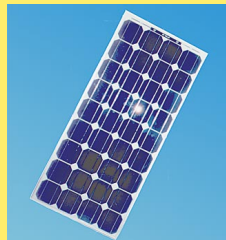
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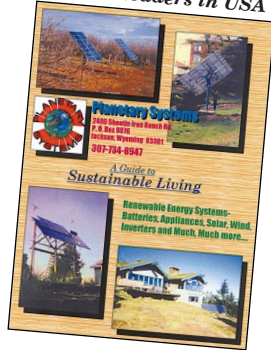


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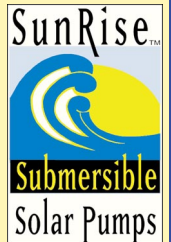


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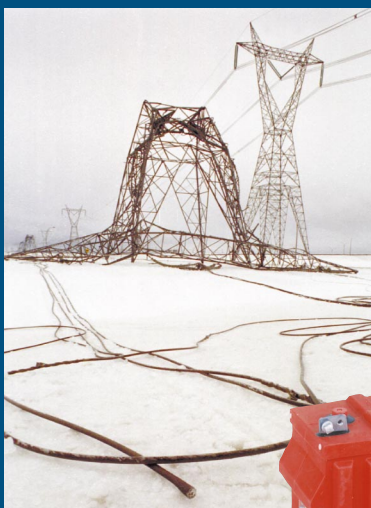
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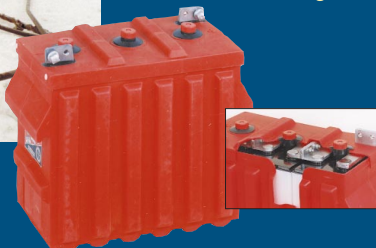
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A Take a close look at the **Solar-One** unique high-utilization positive plate, and you will see that it is our positive grid that provides the foundation for **Solar-One** Positive Plate Technology. Incorporating the highest quality raw material available in the industry. The **Solar-One** grid uses our own metallurgical formulation and a computer-controlled grid casting system, another industry exclusive! The result:

B the **Solar-One** grid contains larger lead crystals, and larger crystals mean fewer points for corrosion to attack the battery.

C To accommodate grid corrosion and growth, many battery manufacturers are forced to use a "floating seal", a battery design which is far more subject to leakage than the **Solar-One's** burned post-to-cover seal. Having controlled the growth of our positive grid, the **Solar-One** seal is stronger and less vulnerable to leakage.

D The key to **Solar-One's**



tradition of longer battery life at full capacity is our patented **H.U.P.** technology (US patent #4,135,829). **H.U.P.** is a process which optimizes both the active material utilization and the longevity of the positive paste. A colloidal suspension of

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E This process known as fibrillation, locks the active material into place and virtually eliminates flaking and shedding - the chief causes of battery failure.

F Tested at the National Battery Testing facility batteries with **H.U.P.** have been shown to increase working life by at least 20%, with absolutely no sacrifice of capacity! In fact, **H.U.P.** batteries deliver full capacity longer, have faster voltage recovery with lower internal resistance, and last longer than conventional batteries. For more power in your Renewable Energy System look for the **H.U.P. Solar-One™** label. High Utilization Positive plate technology only from:



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Remember that it doesn't have to be a big step; it can be a small step. We don't have to be perfect, but we have to do something. That may mean switching over a few light bulbs in your house to promote energy efficiency. ...We can't all live off-grid, so we have to do the little things that bring us to the next level.

Tehri Parker—Co-Executive Director, MREA

MREF '98

Spread the word—Information is power.

Katy Olson—
Outreach Coordinator, MREA



Sue Stein, Tehri Parker, & Katy Olson



Just do it!

Cory Vaughan—
BP Solar



Future builders experience cob

This year, over 11,000 people from 49 states and 30 countries attended the 9th annual Midwest Renewable Energy Fair. Renewable Energy pioneers, key players in the movement, and the public flocked to Amherst, Wisconsin for this three-day extravaganza. We took advantage of the diversity in participants by conducting an informal survey. We wanted to discover what the next logical step in the RE movement might be. We asked:

"What can WE do to further the use of Renewable Energy?"

RE experience from the past and optimism for the future merged in the varied responses. Some are printed here.

Increase the role of [RE] education,...from the elementary grade level through high school, so that we don't wait until kids are in their adult stage to try to change their ways.

Ed Eaton—Solar Energy International

Use more DOE money for education and public awareness, instead of all the boondoggle projects and nonsense as they are using the money for now.

Honest Smitty—AAA Solar Supply

People who are already believers and (users) of RE can continue their lifestyles and lead by example. Show (people) how cool it can be, and (that) it's not that hard.

Sue Stein—Co-Executive Director, MREA



PV technology astounds fair attendees

...Portable solar panels designed to provide plug-in power for consumer electronics...will prevent the use of lead-acid batteries, and alkaline batteries, which contribute to the building of landfills. With the panels, we can recharge rechargeable batteries, as well as power...(these) devices. Use solar in practical applications like this, and we'll be better in the long run.

Chris O'Meara—
Patrick Technologies, Inc.

Bring it into mainstream USA. We should have an RE show on TV, just like the home improvement shows.

Michael Hackleman

With green building materials, you can't find them in stores because no-one ever asks for them. We can do all of this on our own, on a grassroots individual level, but to make an industry change, we really need to be more vocal in our requests to business.

Abby Vogen
—Wisconsin
Building Alliance

Everyone needs to find their own particular role. It may be in the commercial end, it may be in the high science, it may be down in the dirt. Find what we're best at as individuals, and do it.

Windy Dankoff—Dankoff
Solar Products

Political awareness is what we need.

Scott Davis—Yalakom
Appropriate Technology



Windy Dankoff of Dankoff Solar Pumps

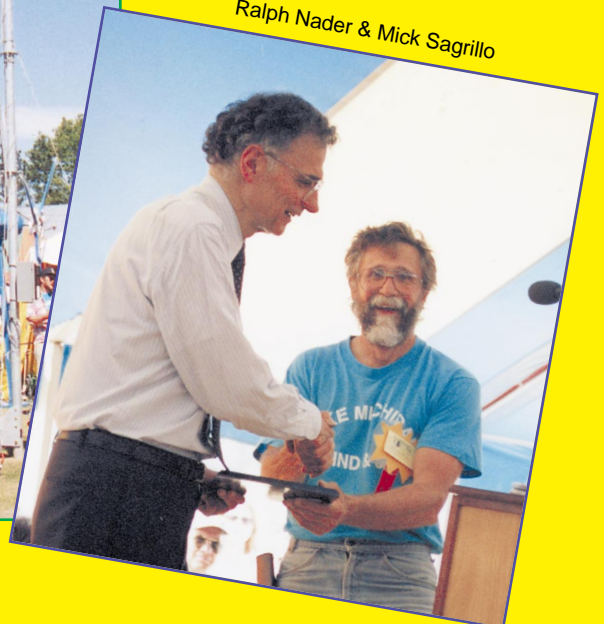
We can use up all the petroleum as fast as we can, and then we'll have to use RE. However, it might be more pleasant to [switch to RE] sooner and more intentionally. We need to figure out how to educate people as to what the real social and environmental costs are. Then people will see the way we've got to go.

Bryce Black—LoTec Windmill Service

We need to be an example for kids and for students out there. We need to walk the talk, so to speak, and set good examples for the next generation. With RE, we need to consider...guerrilla education. Give this [technology] away. Get it in the schools so that kids understand that this is power—this is real. They are the next generation of voters and consumers.

Mick Sagrillo—Sagrillo Power & Light

Ralph Nader & Mick Sagrillo



Wind power is versatile and scalable

Chris LaForge of Great Northern Solar & Dave Katz of Alternative Energy Engineering



If people had to pay the cost of their electricity...instead of the price, then RE would be cost effective. Right now, we only pay the price we're charged for the fuel. It doesn't take into account the health costs, the loss of species, the cost to the environment,...and the battleships we have to have in the Persian Gulf. So, right now, power looks cheap. [To] clarify...the cost of fuel, go back to the Aztecs. ...They dropped a virgin in a volcano to get a good harvest. ...We can figure out how many people we dump in the volcano to have our comfortable lifestyle. It's probably way worse than the Aztecs. ...We've just decided that our lifestyle is worth dying for.

David Katz—
Alternative Energy Engineering

Bring forward the issue of National security. Basically, I'm a patriot. We have to grab the flag with this one...we need to run. We are totally unprepared to defend this nation because we are running off of dead fossil fuels that other people legally own. ...Unless we convert this country to a renewable energy economy immediately, ...we're under threat of total annihilation because we're unprepared on an energy basis.

Chris LaForge—Great Northern Solar & MREF Board of Directors

Crazy Cycling Sun Puppet spreads the word!



People have to be aware of the externalities and the true costs of fossil fuels, in our existing energy system. ...to let them know that renewables aren't that expensive.

Dennis Pottratz—
Go Solar

Eungh

Ralph Nader

(Actually, Ralph had many great things to say, but this sound "bark" shows his feeling about media's attention span. We at HP hope that we can be an exception to the trend.)



Thousands hear Ralph Nader

Our biggest job is to educate the people to the realities of an exhaustible planet.

Greg Lynch—Grain Power Products

A lot of what is represented (at this fair) is counterproductive to what various government agencies want, various controlling powers want, so if we're waiting for their permission, we'll never get it. But it is [RE] technology that the people want, and if they know it's there, they will act upon it.

Mike Holler—GEET Management

To further the use of RE, hemp is one of the most useful plants on the planet. You can make just about anything out of it, all the way from fuel for your car, to clothes, to soaps and lotions.

Terence Urban—Urban Hemp



Greg Lynch and Solar Chef oven

Ben makes \$3 for MREA



We need to start working with our farmers. Wind machines, solar collectors, geothermal, it's all harvesting equipment. In the 30's, we had over two million wind machines in the Midwest, waterpumpers. I don't believe that the farms of the future will be able to survive without wind machines. If we start placing wind machines, one to each farm, we could set that as a goal.

John Root—University of Northern Iowa

If we look at the big picture, it's overwhelming—we become immobilized. If we do what we can in our little part of the world, other people in other parts of the world will somehow think that they can do things too, and things begin to happen. What we can do is what I can do.

John Carr—Rosebud Reservation

Conserve. What we use and how much we use is almost more important than where we get the power.

Elizabeth Willey—Backwoods Solar Electric Systems



Take every opportunity to pass on the knowledge that we've gained about the better choices that are available, and why they are better choices.

Steve Wilke—World Power Technologies

Pioneers need to break the barrier from theoretical ideas to actual practical installation and living with RE systems. ...Then people can actually go and visit an RE system, and can believe it [when they] see it working. Having models there, that people can see and imprint on is the most important thing right now.

Chris Carter—Solar Village Institute

Start with the children. Teach the young people how valuable the resources that we have are. Build up continuity of education all the way up through the Universities.

Armondo Urcuyo—Accucel



John Root of the University of Iowa

Conserve energy, all the time, everyday, whether it's by riding a bicycle or by insulating your house. It's not any big thing, it's lots of little things. If everyone would just buy their milk in returnable gallons, and their beer in returnable 12 oz. bottles, it would do a wonder.

Joe Bacon—Arctic Glass & Window Outlet

Eliminate subsidies to fossil fuels so that the playing field is level.

Kim Bowker—Lake Michigan Wind and Sun

We need to get visible. RE is here and it's good. People can use it, and they can use it today. We need to get into the mass media any time we can. It needs to be the topic of public conversation. When a big wind generator goes up, it should be national news. We need to make it more normal.

Dan Alway—Low Keep Refrigeration



Skip Goebel of Sensible Steam Consultants

We're going to fight for net-metering this year.

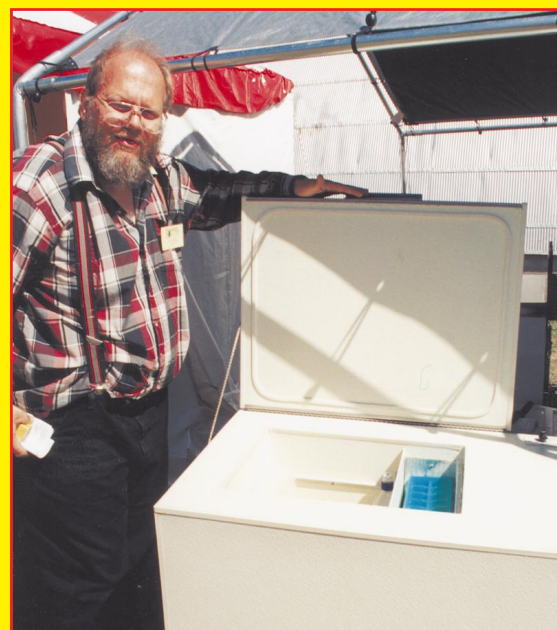
John Dailey—
Alaska Wind & Solar

Help my dad put up windmills.

Zack Dailey—
Alaska Wind & Solar

Show how well (RE) works by example, how a higher quality of life is possible by living off the grid.

Rob Roy—
Earthwood
Building School



Dan Alway of Low Keep Refrigeration

Be consumer activists. Use our purchasing power to invest in renewables not only to stimulate the marketplace, but by our example show our neighbors and friends the value of making that investment. Everyone can make that choice.

Mark Kline—Gimme Shelter

The oil companies and the nuclear power people get a lot of government subsidies...and assistance to sell their products. It really should be the other way around, because the renewables are what's good for people.

Bonnie Mae Newsmall—Yalakom Appropriate Technology



Salvage Galore at Lake Superior Renewable Energy

Let our farmers grow hemp. Recycle much more—renew a lot of our minerals without the mining process.

James Olmsted—Candidate for Lt. Governor, Wisconsin Greens

We have to force our utilities to at least cover the costs to produce (grid power) and then our rates would triple or quadruple, making wind (power) more feasible.

Kim MacMullin—Metcalf Wind Electric

Paul Vargovich & Andy Lopez of En-R-Pak



Use products produced in your local area.

David Nixon—David Nixon & Son

Get involved politically. Make sure our political representatives know...that we are living with RE in our lives, that it's viable, that it's here today.

Wendy Reed—Solar Energy Industries Association

We have to let people know what opportunities are out there, because everyone, no matter who they are, can be excited about using RE when they know how it applies to them.

Jennifer Stein Barker—Morning Hill

Insist that all of the Nuclear Power plants in this country be decommissioned within five years.

Michael Mangan—Independent candidate for Governor of Wisconsin

We need to buy renewable energy just like we buy bottled water, a satellite TV, or the latest computer.

Mark Burger, CEM—US Dept. of Energy

Keep the faith.

Jeff Hayes—Tesla Engine Builders Association

Get out there, grab an oar, and keep rowing.

Jim McKnight—Gimme Shelter

We need a nationwide net-metering bill.

James Lamb—Middle Fork Engineering

If you want to get the masses involved in this, the economics of it have to be right. What needs to happen is that we have to have the right products at the right price.

Gary Chemelewski—Exeltech

Start living by example and implementing it ourselves.

Melanie Thibodeaux—Solar Energy International

Take a show like the MREF, and take it to where the people are. Take it to population centers...and we can educate a lot of people at one time.

Gunars Petersons—Alternative Power

Be positive, and educate.

Kelly Larson—Alternative Energy Engineering



Stirling Generators by Sunpower

Midwest Renewable Energy Fair Access Information:

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Web: www.msn.fullfeed.com/~hulet/



Kelly Larson & Michael Welch

HAM Radio at MREF '98



Above: The HAM Crew at MREF's special event station.

New this year, was an active Ham radio station on the MREF fairgrounds. Thanks to the hams who helped set-up, operated the station, and answered questions from the dozens of people who stopped by the tent each day.

We learned a lot this year. Starting out, we discovered that the close proximity of the power lines meant that we had inverter noise at 20 db over S9 on all bands, so shortwave contacts were limited. (For you non-hams, that means we could not hear any but the very loudest stations.) Another surprising thing was that our solar panels, an old set of Carrizo "mud" quadlams, were actually receiving the noise and re-radiating it due to a corroded connection. The connection was redone and the noise level dropped a bit.

VHF FM contacts were successfully made through repeaters and on "simplex" with several Hams in the Stevens Point and Waupaca areas. Six or seven of the people contacted came out to learn how to run an amateur radio station on solar power. Next year, we hope to be back and in a location out of the general area of the inverters even if it means we won't be using the windmill tower as a support for the dipole antenna.

Bill KA9SWW • dbill@uic.edu



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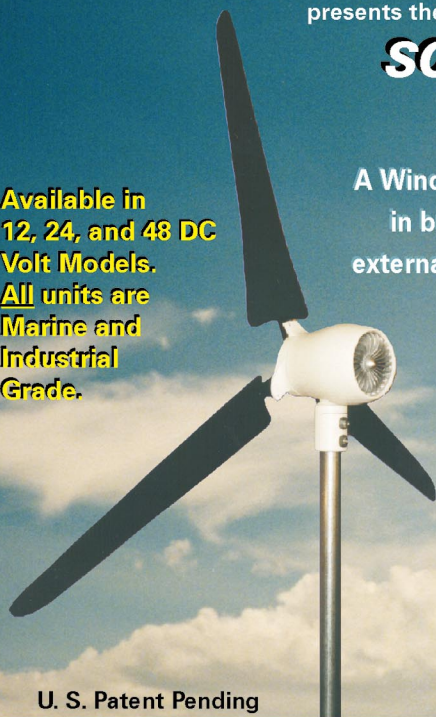
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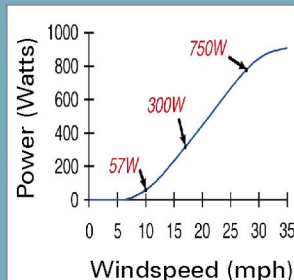
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Performance Chart



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C12 (Shown with cover removed)

C12

The C12 has an LED status light displaying both charging functions and battery charge state at a glance. This controller is used worldwide in a variety of applications. The DC disconnect function of the C12 will disconnect DC loads if batteries reach low-voltage conditions. Thousands in use worldwide. All controllers feature exclusive optional battery temperature sensor which maximizes battery life and charge. List \$110

*Scheduled availability Sept. 1 1998.

DR Series

Simple & Expandable

High surge capacity, low idle current. Simple, powerful, reliable, and efficient, Trace DR-series inverters have set a new standard for inverters. Trace builds several models of DR-series inverters, ranging in size from 1.5 kW to 3.6 kW. All DR inverters have a built-in, automatic, three-stage battery-charging system (bulk, absorption, and float). Auto low battery protection.



Fast auto switching for back-up power. Expandability is another unique feature of our DR-series inverter. Load capacity can be doubled by "stacking" a second inverter. A simple stacking cable kit (DRI) is all that is needed. When connected in series, a pair of DR inverters produces both 120 and 240 Vac power, enabling it to operate such difficult household loads as deep well pumps, heavy power tools and appliances. Battery temperature compensation option. List \$995 to \$1,350.

UX Series



500 to 1400 Watts of Power
The new UX family is a powerful compact upgrade of the 800 Series. UX offers higher power with UL compliance. Automatic Operation Combination inverter/charger (StandBy) models include a built-in battery charger and automatic mode switching that provides true "set it and forget it" operation. ETL listed, UL standard 1741 - CEC approved. List \$550 to \$940.

NEW Tiger Series*

New low cost maxi-feature, modified sine-wave inverter with optional 3-stage battery charger & automatic transfer relay. More features, higher reliability and surge power than any other inverter in it's price range! List \$395 to \$495

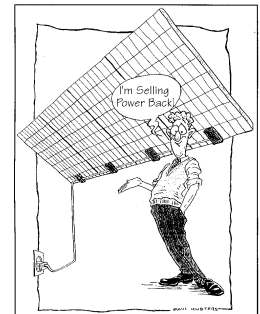


Micro Sine



Micro Sine Module

Trace Engineering is leading the way once again with our new miniature utility interactive inverter—the Micro Sine Module. Designed to fit on the back of an individual PV solar module. This totally weather proof inverter produces utility-grade power suitable for supply to a power distribution grid. Meets NEC requirements - ETL listing pending. List \$345.



SW Series II



SW 4024 - List \$3,410

New Series II Design

Don't settle for less! Used with utility interactive systems worldwide. Features include an easy to use programming system with separate "User" and "Setup" menus. Battery Charger with high efficiency, low current distortion design enables higher charger output from small generators. Output of these inverters is so clean that they are approved for utility interconnect. Meets NEC requirements. Approved by the California Energy Commission.

SW models are available in utility interactive and stand alone configurations. Auto generator start, battery voltage transfer mode, and PV power point tracking are all available. 54 microchip options. DR, UX, SW & MPS Series are ETL listed - standard UL 1741. List \$2,585 to \$3,970

Trace Power Modules



MPS shown with cover removed.

An MPS encloses inverters, charge controllers, wiring, disconnects and batteries in a lockable indoor/outdoor weatherproof cabinet. The modular design facilitates installation standardization and permits maximum flexibility. Meets NEC requirements. Approved by the California Energy Commission.

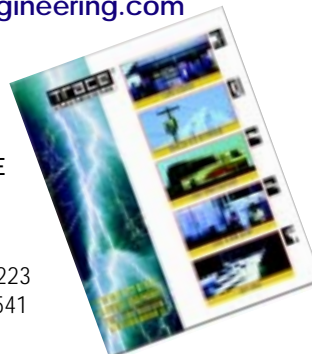
Ground Fault Protectors are now available for solar panels and can be installed in the MPS.

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Solar on the Go: *RE on an RV*

Rush Dougherty

©1998 Rush Dougherty



Above: Author Rush Dougherty relaxing next to his self-sufficient Hitchhiker II.

In May of 1995, I left Long Island, New York with a 10' slide-in camper on my new 4x4 Ford F-250. My plan was to spend at least three years traveling around the US and Canada. I wanted to be as self-contained and independent as possible. I had a lot to learn.

A Home on the Road

The camper was small—when I stood in one place, I could be in any of four different rooms depending on the direction I was facing. The kitchen was on the driver's side. To the right, my bedroom was in the cab-over, and next to that, the living/dining room was on the passenger side. One more right turn, and there was the bathroom and the entrance/exit. The camper had a 20 gallon freshwater tank, and for gray/wastewater I installed an additional 20 gallon tank.

The System

I knew that there was this thing called solar energy that would enable me to be free of plugging into an outlet. At that point, that's about all I knew. I started educating myself, called around, and bought two SCM40 PV panels. I installed them on the roof of the camper. The old Gold panels, purchased from Sunlight Energy in Arizona, were originally from the San Luis Obispo plant in California and had been reconfigured for 12 Volts. They were rated at 40 W, at 2.4 Amps each. I hooked them up together to get 80 Watts at 4.8 Amps. They came with a Specialty Concepts Mark III/15 regulator.

I stored my energy in two 6 V golf cart batteries connected in series (220 Amp-hrs). This gave me 12 Volts, which fit right into the camper's existing system. The batteries were connected to the one stage battery charger in the camper. This charger was then hooked up to the electrical system in the truck. For my ac needs, I had a PowerStar 700 W inverter. In the bright but cold March sunlight, the output from my panels was a little over 5 Amps, certainly more than specified.

Ready, Set...

I culled through everything I owned for the things I wanted and thought I needed to take with me on the road: tools, scuba equipment, my full size computer and monitor, a 13" color TV, a Sony Hi-8 Video camera with equipment and playback unit, personal papers, and some clothes. It was crowded, to say the least.

My system was self-contained and ready to go. I had water, power, heat (propane), and shelter in a truck that could go almost anywhere. I left my family (I was recently divorced), friends, and New York, where I had been for 27 years, and set out on a three year journey. My plan was to go down the East Coast until I reached the Carolinas, then sort of head west, hit Texas, and go north to Nebraska to visit a good friend that I hadn't seen for a couple of years. After that, I would decide where to go. Maybe I'd head on up to Canada, then over to the Northwest coast and down to the Southwest.

Traveling Simply

Everything seemed to work fine. While I was driving, the batteries would charge from the truck. At rest, the solar panels would kick in when there was sun, and if I saw on the regulator panel that the battery indicator was low (in the yellow range), I would hook up to shore power. My only ac draw through the PowerStar inverter was from the TV (85 W) and the computer and monitor (about 300 W). The water pump, interior lights, electronic circuits for the refrigerator (propane when not connected to shore power), and furnace circuits/motor were all 12 V DC. My refrigerator could also be run on DC. I did that once, and watched the battery meter on the regulator go down really fast.

I stuck pretty close to my intended route with lots of detours in all directions. I stayed in private campgrounds, national parks, state parks, recreation areas, dirt roads off the main roads, etc. About half the time, I hooked-up to water, electricity, and sewer facilities. Otherwise, I would just get a "primitive" site with no hook-ups. If I needed water, I could always stop at a faucet and fill my fresh water tank. When I needed to empty my waste tank, I stopped at the dumpsite on the way out of whatever park I was visiting.

A few times, my inverter started to whine, letting me know that it was going to shut down if I kept on using the batteries at the current draw. I learned to look at the battery voltmeter on the solar regulator to find out



Above: A varied array of PVs on the roof of Hitchhiker II.

whether I was able to stay independent or if I needed to hook-up. It was a very simple system with very little demand, which was fine for me.

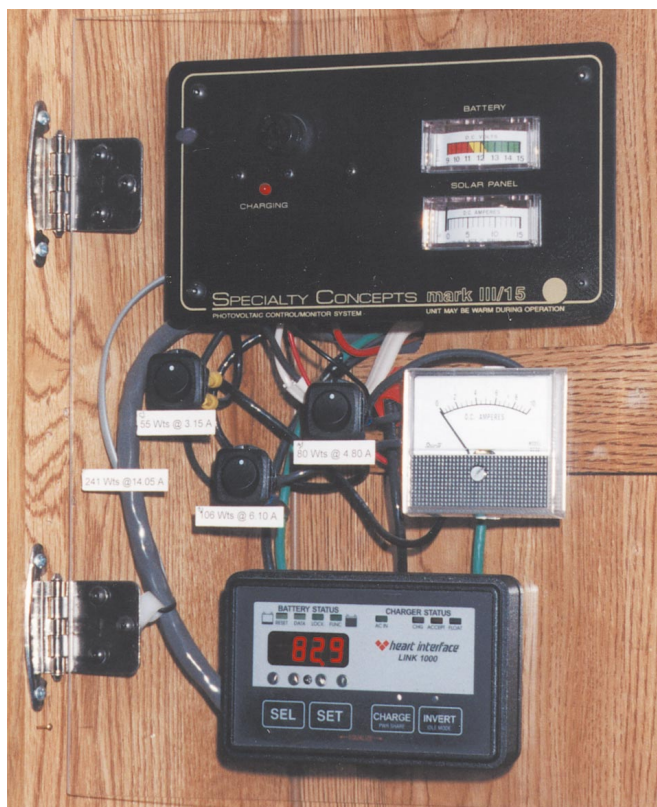
Simply Complicated

When I was driving, my whole truck would sway and lean on curves. I had approximately 4,000 lbs. on the bed of my truck and the center of gravity was high above the ground. I had planned to take the camper off of the truck as soon as I arrived at a destination to be able to explore the back roads, woods, country, or town I was in using the 4x4 capability of the truck. Instead, I found that I was just sitting at campsites a lot.

Very quickly, it became a real chore—I had to crank the 3 support legs down, remove the things (batteries included) that I had stored between the bed of the pickup and the sides of the camper, store these things inside, unhook the electrical and mechanical connections to the truck, and slowly drive the truck out from under the raised camper. Finally, I had to lower the camper down onto some boards so that it would be stable and so that I could get into it. As the process took about 45 minutes, it was not something that I looked forward to. Putting the camper back on added to the level of difficulty, because I had to back up the truck precisely underneath so that the space between the bed and the camper on each side was equal.

Solar 5th Wheel

On the road, I looked at other people hauling trailers or 5th wheels. I was envious of the space they had, and that once they arrived at their campsite, they could unhook and be free of their trailer. I also wanted to be able to take at least a couple of steps in my home



Above: SCI Charge controller, array disconnects, ammeter, and Link 1000 system metering.

before being stopped by a wall. I talked to people and learned that a 5th wheel “followed” better than a trailer with a bumper hitch. The tongue weight on a 5th wheel is placed on the rear axle, distributing the weight more evenly over the whole of the tow vehicle. Since the pivot point is also forward, 5th wheels are more maneuverable, especially when backing up.

When I arrived in Grand Island, Nebraska, where my friend Judy lived, I offloaded my camper in her parking lot and started looking for a new home. After about a week of going to dealers in the area and scanning for sale ads, I settled on a 1987 20' Coachman Coventry 5th wheel. The salesman saw me coming. I transferred all of my stuff, reinstalled the PV panels and batteries, and took off again.

On the Road Again

I went north through the beautiful Dakotas, into Canada and then back east along the border. I visited incredible campsites, dove with the seals in the Bay of Gaspe, Nova Scotia, and ate fresh lobsters on the Maine coast. I detoured to Shepherds Ford in Virginia for a family reunion and celebrated my 50th birthday. It was great to be able to stop where I wanted and not be electrically dependent. I could unhitch my 5th wheel in about 10 minutes, and then be free to explore with my 4x4 truck.

From there, I went south and traveled along the Gulf Coast. Passing through Morgan City, I saw the derricks and rigs burning excess gas offshore. It really drove home the point about just how many parts of our economy intensely depend upon black gold. I visited the hot springs in Big Bend National Park, camped next to an old airstrip at Stillwell Crossing, and took hikes in the Sierra Del Carmen foothills. My PV panels were great in the foothills. It was extraordinary to be in the middle of nowhere and have all the comforts of home such as ice cream and cold water. It had been about a year since I had stopped for any amount of time and I felt the need to rest for a little while. I found a little trailer park in Austin, and stayed there for about a year and a half. I enrolled in Austin Community College, got a certificate in Integrated Circuit Layout, and did AutoCad drawings at Applied Materials for about 8 months.

Another Solar Big Rig

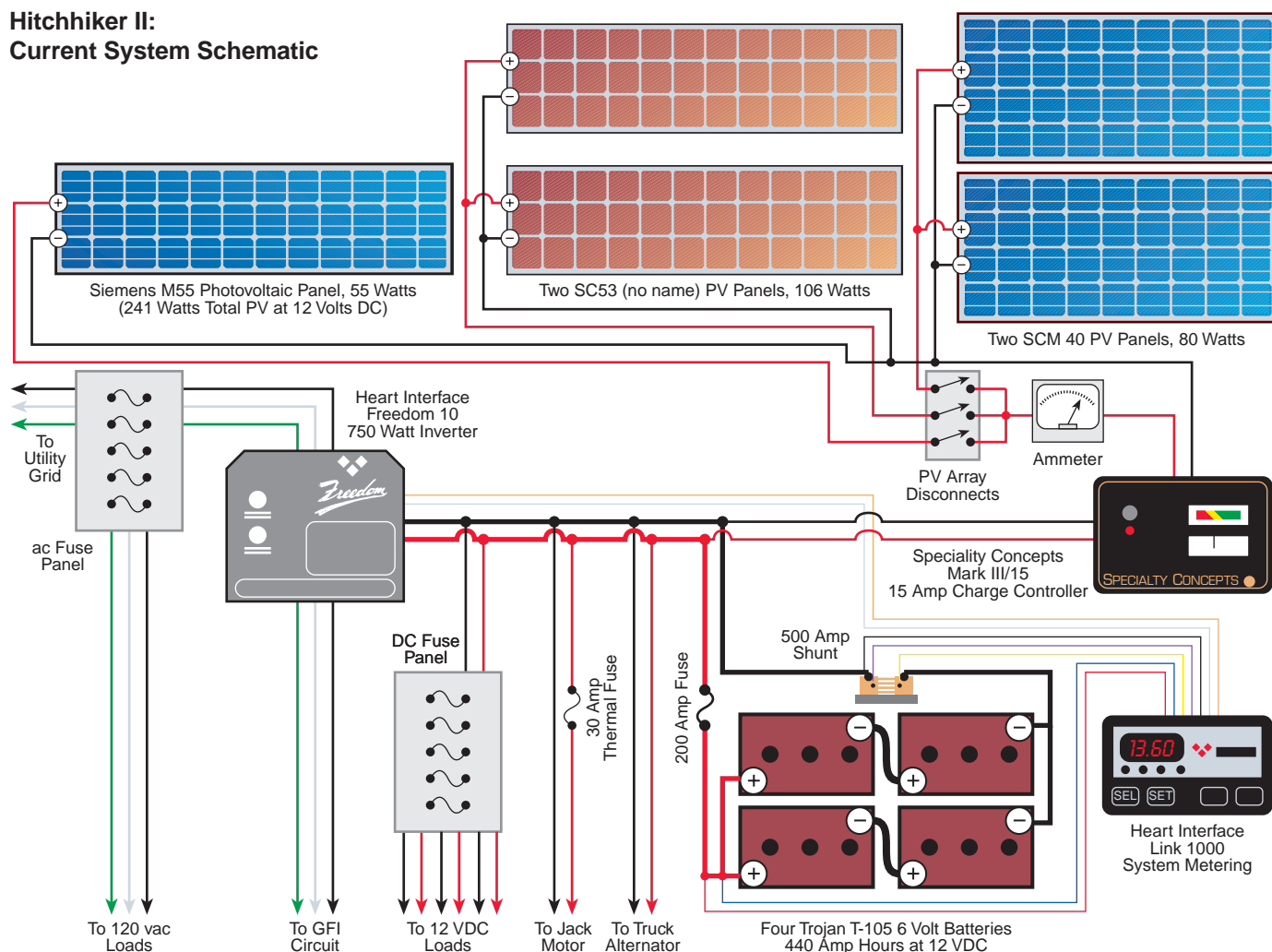
I started getting antsy again, wanting to move on. My 20' 5th wheel was getting small, and I knew that I couldn't be comfortable in it anymore. I started looking around for another home on the road. A dealer in the area had a 1992 24' Hitchhiker II. The insulation was much better than in the older Coachman, and it was 4' longer, had more storage space, a “basement”, and was in better shape. It also had a slide out which gave me the impression of living in a palace. I traded the Coachman in for the Hitchhiker II at the end of March, and started modifying it for my use.

The RV industry is very appearance conscious, full of glitz and gaudiness. My new 5th wheel had gold tinted curtains and valances that seemed ludicrous to me. They are gone. The door of the refrigerator had a full 1/2" oak panel on it. Every time I opened it, I felt like I was moving 10 pounds of “beauty”. The doors and drawer faces are oak (the old Airstreams were weight conscious and had tambour sliding doors). The slide out area had a couch that converted into a double bed, which was something that I just couldn't envision using. If a couple comes to stay with me, they can use my queen-sized bed, and I'll sleep on the sofa. I removed the foldout mechanism and the extra layer of foam, and gained about 10 cu. ft. of storage space. In the dinning area, I installed a desk for working on my computer. It is a 30" by 5' hollow core door that is supported at one end by the wall, and at the other end by a filing cabinet which contains all of my papers.

System Specs

Most of my power needs are 12 VDC except for the TV, computer, some power tools, and battery re-chargers. All of my lights, which include a mixture of automotive bulbs, fluorescent, and low voltage compact fluorescent (CF), are 12 VDC. The ammonia evaporation

Hitchhiker II: Current System Schematic



refrigerator uses either 12 V or ac (when I am plugged into shore power). The furnace and hot water heater both use propane and a 12 V ignition. However, the furnace also has a 12 V fan. The water pump is also 12 V and is used very little. I do have a 12 V fan that I run to circulate the air when it is hot inside. There is a 12 V radio system in the trailer and I have a CD cassette player attachment. I average about 30 to 35 Amp-hrs of use per day, and that varies greatly. Where I am now, on BLM land in Southern Arizona, there is no TV reception.

The ac electric panel is on the rear left side, the DC Panel and Magnetek charger are on the middle right side, and the battery area is in the front, 20' from the charger. The walls have an insulation value of R-8 and are 2" thick with fiberglass insulation. The ceiling is R-14 and 5" thick with fiberglass, so the values seem right. In any case, the interior temperature during a hot Texas day is noticeably cooler than in my old 5th wheel.

In the summer time, my furnace doesn't run, but my fan does. When I can plug into shore power, I try to use it

as little as possible. For the month of September, I was in a park in Chimacum, Washington, and my electricity bill was \$3.00.

System Upgrade: PVs

When I first got the Hitchhiker II, I thought about what I wanted to do with my new home. Some of my best experiences have been when I was alone in some wilderness area, independent yet comfortable. So I decided to increase my independence by getting two more PV panels and upgrading my ac/DC system. I shopped around and finally bought two SC53 panels from Sunlight Energy Corp in Arizona. They are rated at 53 Watts, 3.3 Amps, and 17.4 Volts. They are a "no name" brand, but are made from Siemens' PV cells. The specs for these panels match the M55 specs, but the dimensions are different. I assume that for some reason they didn't meet the Siemens' standards.

I installed the PV panels on the roof. My roof is standard for the travel trailer industry. It can be walked on and consists of EPDM rubber on top of 3/8" plywood overlay with 2x4 studs. I tried to place the sets of



Above: The Four Trojan T-105s provide 440 Amp-hours of storage

panels so that at least two of the four corners were securely anchored into the 2x4s underneath. I used putty as a seal between the rubber and aluminum feet and then sealed with 501-LSW. I can angle the panels in one axis only, so I have to be careful to park in an east-west direction to get the most out of them. The lead-in wires are #10 stranded and go from the panels into the trailer through a PVC waste vent pipe. The waste pipe is in a closet, so I drilled a hole in the pipe, snaked the wires into the closet, sealed the hole so that the odors would vent normally, and then fed all the wires through walls to the monitor center.

System Upgrade: Components

In addition to the new panels, I also wanted to be able to have a larger ac capacity. I looked into inverters and found that the Heart Freedom 10 would suit my needs. Since it is a modified sine wave inverter, I have to hook-up to shore power to use my HP 5L LaserJet printer. This inverter also gives me a three-stage 12 V charger that I substituted for the one that came with the 5th wheel, which was only a one-stage charger. To monitor my power supply and usage, I initially got an E-Meter from Cruising Equipment Co. After reading a little more, I exchanged it for the LINK 1000. Both the LINK 1000 and Freedom 10 came from Delivered Solutions in Temecula, CA. Tom, of Delivered Solutions, helped me through several installation questions. I also found the technical help at Cruising Equipment very valuable.

I chose a place for my "monitor center" in the main part of the 5th wheel. The center consists of the Specialty Concepts solar regulator and the LINK 1000. I also wanted to see what the old and new sets of panels

were putting out, so I kept the incoming lines separate. The lines are on switches, which are connected to an inline ammeter. The ammeter feeds into the solar regulator so that each set of panels can be read and turned on and off individually.

Tricky Wiring

I placed the Freedom 10 in the front of the 5th wheel, close to the batteries in the basement. To connect the charger to shore power, I ran a Romex 20/3 line from the ac fuse panel in the rear of the 5th wheel to the Freedom 10. It was difficult. I found a small space next to a heating duct and got the wire around some small but tight bends. To do this, I took the cover off of the heater. With determination, I

pushed, at arm's length, 5' of 1/2x1/2" Romex around a block of wood that was in the way.

From my monitor center, I ran wires down through the closet and into the "basement" where the Freedom 10 and batteries are located. These wires include the power feed from the solar regulator, the LINK 1000 monitor cable (eight-wire twisted 16 AWG cable from Heart Interface), and the four-wire telephone cable interface that runs between the Freedom and LINK.

I installed the Freedom 10 horizontally and raised it up 1/2" for better access to air. The basement is normally kept closed, but I can always open up the access doors if it gets too hot while I'm parked out in the sun. The Freedom 10 is grounded to the chassis with #8 AWG wire. I have one 20 Amp ac circuit coming out to a GFI box. This is my ac source when I am boondocked in some place like Black Gap Wildlife Management Area, or like now, when I'm on BLM land above Organ Pipe National Monument in Arizona.

The new wiring is a little bit more complicated than the original. While I am fairly knowledgeable about how electricity works, I am not a skilled electrician. At times, the installation was a challenge. The existing DC fuse center that was in the old Magnetek Charger had nine fuse holders, six of which were used. I noted all of the connections, disconnected everything, and removed the panel from the Magnetek box. I installed the panel in a new plastic load center, rewired the connections, and turned on the power. Nothing worked. It took me a good hour to realize that the Magnetek DC panel was actually a printed circuit board consisting of two separate circuits. The first was a six-fuse circuit wired to

Hitchhiker II Loads

<i>Appliance</i>	<i>Watts</i>	<i>hrs/ day</i>	<i>W-hrs/ day</i>	<i>%</i>
Furnace	98.40	1.25	123.00	28.84%
TV	59.04	2.00	118.08	27.68%
Laptop	19.68	3.00	59.04	13.84%
Big Computer	70.11	0.50	35.06	8.22%
Monitor	55.35	0.50	27.68	6.49%
Living Rm. CF	11.07	2.00	22.14	5.19%
Water Pump	73.80	0.25	18.45	4.33%
Bedroom CF	9.84	1.00	9.84	2.31%
Water Heater	61.50	0.10	6.15	1.44%
Living Rm. Fluor.	23.37	0.10	2.34	0.55%
Kitchen Fluor.	20.91	0.10	2.09	0.49%
Bathroom Fluor.	14.76	0.10	1.48	0.35%
Kitchen CF	12.30	0.10	1.23	0.29%

total 426.56

the power coming from the Magnetek charger. The second was a three-fuse circuit directly connected to the battery. I had connected everything directly to the battery lug on the board, so there was no connection to the charger circuit. It was a simple matter to connect a jumper from the battery connection to the other part of the board. After that, everything worked fine.

Batteries

Initially, I decided that my two 6 V golf cart batteries were fine. A 12 V RV deep discharge battery came with the Hitchhiker II, so I just paralleled it with the two 6 V batteries in series. I thought I would have 330 Amp/hrs of storage, but later I learned differently. As described in the Heart Interface installation instructions, I installed a 200 Amp Class T fuse for the Freedom 10 on the positive side of the batteries. I used a Gould distribution block to connect the various positive feeds. On the negative side of the batteries, a 500 Amp 50 mV shunt was installed for the LINK 1000. The LINK 1000 is wired to the battery according to Heart Interface specifications. The negative side also has a Gould distribution block for interconnects. All wires from the batteries to the distribution blocks are #2. From there, I used the existing wiring.

I was told that the 12 V battery was the worst one in my system, and that the battery system performs only as good as the worst battery. I removed it and noticed an improved performance from just the two 6 V batteries. Last November, I upgraded to four Trojan T-105s, and wired two each in series-parallel. I now have 440 Amp/hrs reserve. I also installed HydroCaps because access to the batteries is a little cramped and I am told that they conserve water. We shall see.

To the MREF

I left Austin and made my way up to Amherst, Wisconsin to attend the 1997 Midwest Renewable Energy Fair in June. I really learned a lot there. The amount of information was staggering. I concentrated mainly on solar and batteries, but I also learned a lot about wind and water power, straw bale building, etc. Every workshop I attended was full of information. While many were not directly applicable to my present needs, they all certainly raised my level of awareness about renewable energy. I went to as many workshops as I could, and decided that my next house would be as energy efficient as possible. I have dreams of selling electricity back to the grid. I put a bid on one of the Siemens M55 panels up for auction. Much to my surprise, I got one. Now I have five modules, for a total of 241 Watts at 14.05 Amps. My controller is at its limit.

Living with the Sun

It is December 26th, and I am sitting on BLM land near Ajo, Arizona. My only limiting factor is the capacity of the waste holding tanks. With care, I can stay here about eight days. I have four more to go. The weather was rainy here a couple of days ago and the Ocotillos are getting new leaves. Now it's beautiful and sunny, and the batteries are fully charged.

I just checked the time on the sundial that I made when I got here. It's 11:30 AM, and soon will be local noon, which occurs around 1:15 PM. The PV panels are angled at 45° to magnetic south, except for the SC 53's, which lie flat and therefore have shadow interference from the SCM 40's. One of those planning errors.

At this time of the day, these are the Amps being fed into my RV from the sun:

<i>Panel</i>	<i>Rated Amps</i>	<i>Measured Amps</i>
Two SCM40's	2.4	2.7 (4.7 at 45 degrees)
Two SC53's	3.05	6.2
One Siemens M55	3.15	3.5
		Total 12.4

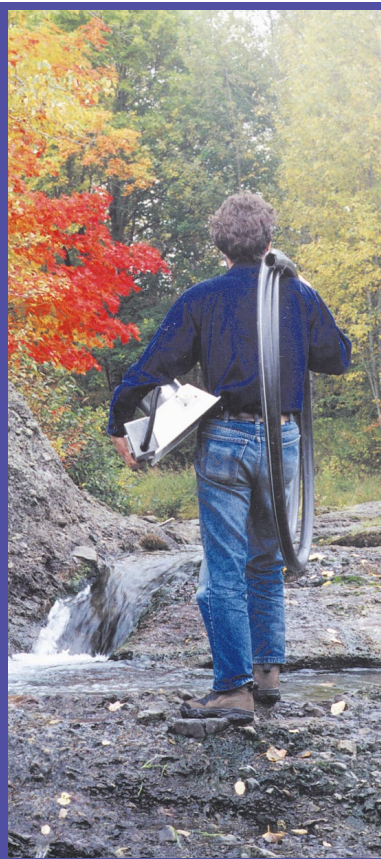
If I remounted my SCM40 panels, I could have 14.4 Amps instead of 12.4 on a day like today, but I'm happy for now with what I have.

This article and the preliminary drawings have been done on my laptop, powered by my panels. I have also just finished the plans for a straw bale house that I want to build. I'm going to have a dish of ice cream to celebrate. I love my independence!

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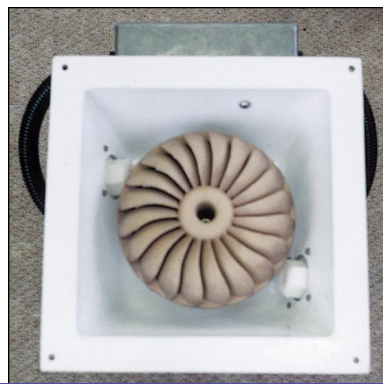
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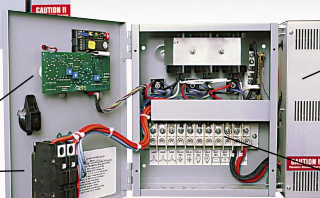
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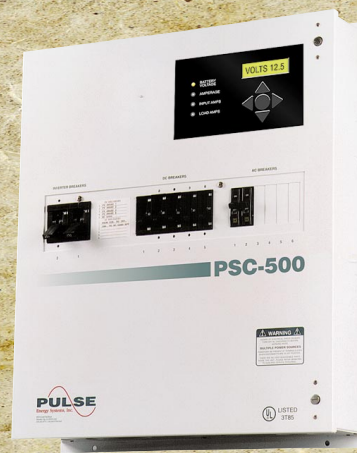
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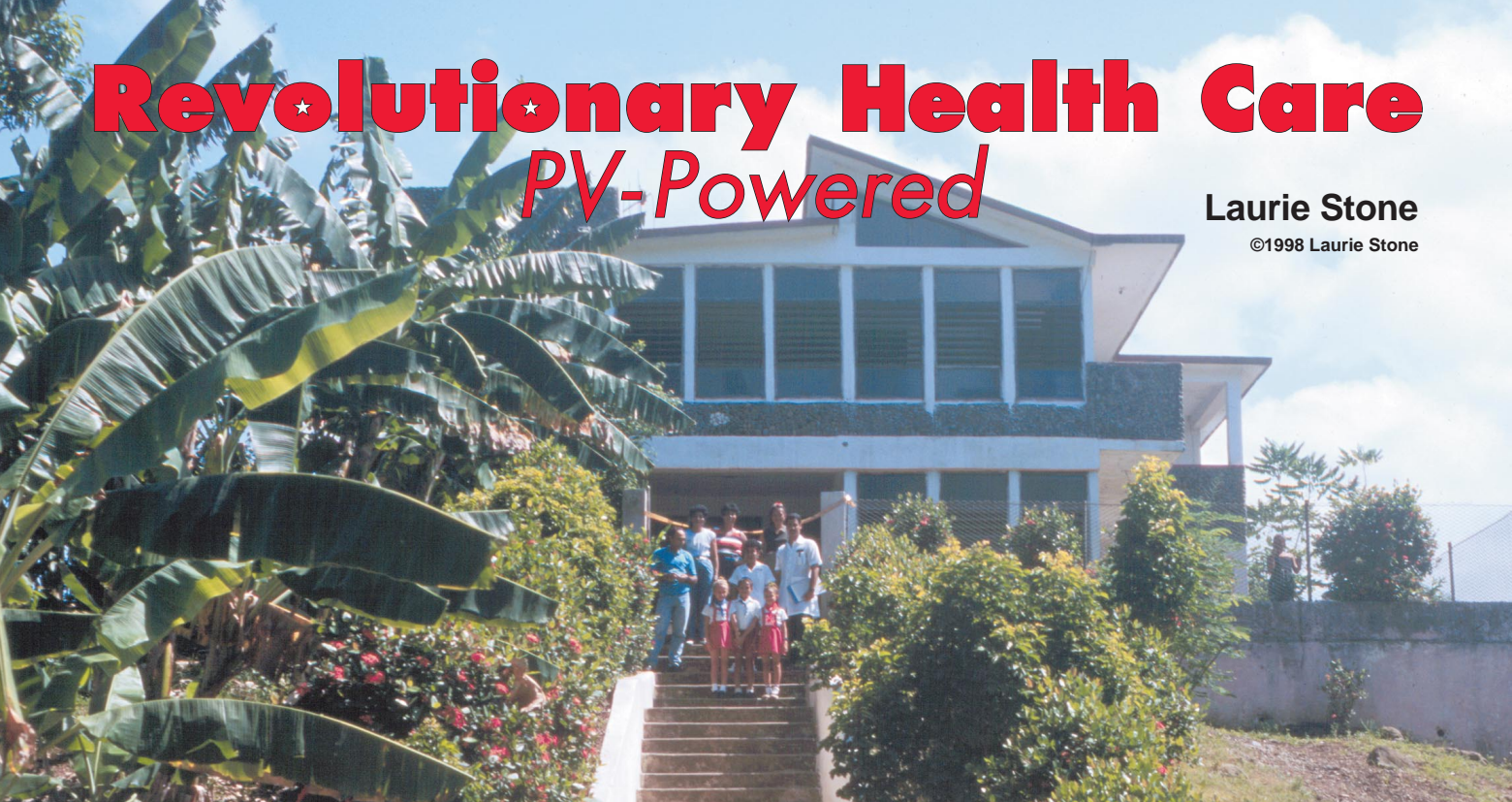


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Revolutionary Health Care PV-Powered

Laurie Stone

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Cuba provides premium health care to all areas of this economically depressed island. To ensure adequate health care in remote mountain regions, Cuba is embarking on an ambitious PV electrification program.

Cuba's Health Care

Every year, over 2 million children die from diseases that could have been prevented with vaccines. Two billion people live without access to electricity, causing many doctors in the developing world to perform surgery with flashlights or candles. In a world of such atrocities, it's inspiring to see a "developing" country that places top priority on people's health.

Cuba's health care system has been unrivaled since the 1959 revolution. The infant mortality rate is 7.2 per 1000 live births, while the life expectancy at birth is 76.1 years. This is on par with or above even the most industrialized nations. The national health system includes a network of institutions that provide coverage to 100% of the population. In every community, there is a family doctor and nurse who live and work there. In 1992, there were over 18,500 family doctors on the island. Between 1959 and 1989, Cuba's electrification program brought the electrified population up to 95%. Still, there are over 300 family doctors living and working in remote rural areas without electricity from either the national grid or the many micro-hydro systems around the country.

Above & Below: The Baez Health Clinic in Guantanamo province, Cuba.



Cuba has relied heavily on foreign oil, having very little of its own. Most of this oil has come from the former Soviet Union on advantageous terms. The fall of the Soviet Union added to the already difficult circumstances caused by the economic blockade imposed by the United States, which has been in place for over 30 years. Cuba desperately needed to cut back on its oil consumption. Despite these hardships, Cuba has forged ahead with the plan to bring adequate health care to every Cuban citizen.

CUBASOLAR

In 1988, Vladimir Diaz Denis and his wife went to work as doctor and nurse in a small community called El Mulato. The community of 400 had no electricity and was so remote that when the health clinic was built one year earlier, the building materials arrived by helicopter.

In the first year of Vladimir's work there, the clinic had a kerosene lantern for light. At night, when he treated people, he used a flashlight. One night, while his wife held the flashlight, he put stitches in a two-year old boy. Needless to say, conditions were rough.

CUBASOLAR is a non-governmental organization promoting the use of renewable energy and energy consciousness. In 1989, they conducted an evaluation of the community. After the government analyzed the evaluation, they decided to electrify El Mulato with photovoltaics. Vladimir's health clinic became the first in Cuba to be electrified with PV. Thus began CUBASOLAR's ambitious program to bring PV to all of the rural family doctors' clinics.

PV Powered Community Centers

As of May 1998, 170 of these clinics in the remote mountain regions of Cuba have been electrified with PV. These systems have increased the quality of life and decreased the infant mortality rate in these areas. Initially, all of the systems included lights, a vaccine refrigerator, and other medical equipment such as electrocardiographs and x-ray machines. Because each clinic has a live-in doctor, the systems were modified to include a TV and radio.

The people at CUBASOLAR found that the children of the community were crowding around the TV at night. Because the TV was in the doctors' quarters, this left him without any down time. Now, when they electrify a clinic, they usually also install PV on the community center for TV and other social functions.

Radiotelephones Save Lives

Very shortly after CUBASOLAR's electrification program, there were many health improvements in remote areas. Still, something was missing. The systems were all in remote regions, and when there were very serious cases, the doctors had no way to communicate with ambulances or hospitals. Thus began the program to add radio communications to each PV powered health clinic. Of these 170 clinics, 130 of them now have radiotelephones, allowing them to communicate with hospitals in the larger towns. The radiotelephones have already saved numerous lives.

Each communications system consists of a 25 Watt radiotelephone and costs \$870 including the antennas, repeaters, and communication equipment necessary for the ambulances and hospitals. The radiotelephones have been used to save lives during hurricanes and floods, to request ambulance or helicopter assistance, to inform relatives of the condition of a patient in a hospital, to inform hospitals about the status of vaccination campaigns, to ask for specific medicines needed by the clinic, and to solicit help from medical

specialists. The communications equipment adds only slightly to the cost of the total PV system.

PV System Components

Although the PV systems at each health clinic vary slightly, a typical system includes:

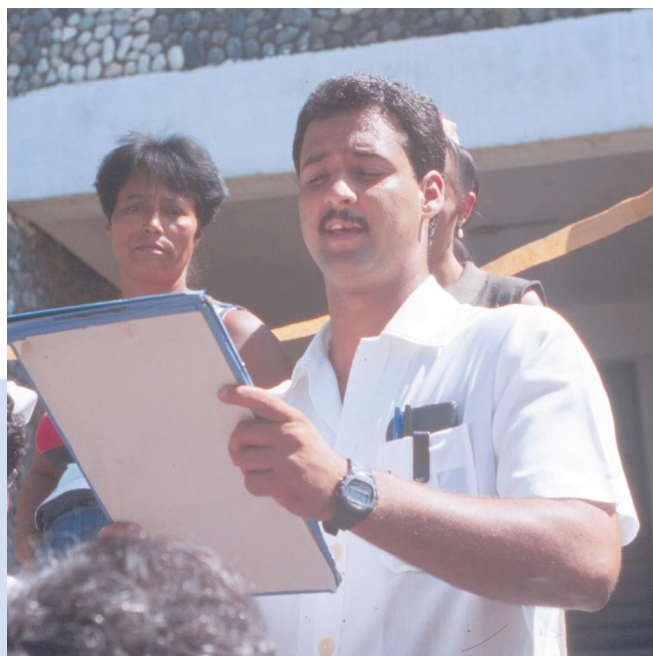
- 300-400 Watt PV array
- 30 Amp charge controller
- 400 A-h 12 Volt lead acid battery
- 14 fluorescent 20 Watt lights
- (1) 15 Watt TV
- (1) 25 Watt radiotelephone
- 3 electric medical tools
- 1 DC vaccine refrigerator

Improved Lifestyles

A doctor from the recently electrified Baez clinic in Guantanamo province believes that the PV-powered electricity has contributed to a very high quality of medical care in the community. He is convinced that the solar installations demonstrate "how to develop without polluting the world we live in."

The electrification of the clinics has brought much more than improved health care to the mountains. Vladimir Diaz Denis has noted significant improvements in all areas of life. When Vladimir arrived in the small coffee and fruit producing community of El Mulato, there was not a single newspaper. There were six pregnant girls under the age of 14, three of whom were under the age

Below: A Doctor from the Baez Health Clinic.



"Concentrated, hard or conventional energy (this is oil, coal and nuclear reactors) is a weapon.... Since a long time ago, the principal cause of wars in the world has been energy. Who controls the energy, controls the world.... It was also used against the Cuban Revolution, when one of the first measures that was taken against Cuba was to cut us off from the oil delivery. Conventional energy responds to the interests of the rich, of the powerful, and makes the poor each day poorer, more indebted, more enslaved. Renewable, soft or non-conventional energy (this is solar), is a weapon against capitalism and against imperialism, yet it is for everyone. The sun shines for the Chinese, the Blacks, the Indians and the Whites; for women, men, elderly and children; for the poor and it is so generous that it also shines for the rich. The sun can't be blockaded, it can't be dominated, it can't be destroyed. Solar energy is a weapon of the people.... It is the only thing that can produce the true economic and social development that humanity needs."

— Luis Berriz, President, CUBASOLAR

of twelve. There were eleven children with learning disabilities, and 151 at-risk alcoholics. In 1989, CUBASOLAR installed a 48 module, 1.5 kW PV system to provide electricity to the clinic, community store, community center, and two houses. Separate 400 Watt systems were installed on 30 additional houses. Vladimir says that the change in the community was like the difference between night and day.

The health situation in El Mulato improved greatly with addition of the vaccine refrigerator and electrical medical equipment. Improved health also influenced the local economy when coffee and fruit production increased dramatically. In addition, electricity brought additional opportunities for women. This resulted in a decrease in average birth rate, which went from five or six children per woman down to two or three.

The emotional wellbeing of the children also improved. Vladimir noticed that they no longer walk hunched-over, but stand up straight instead. In photos that were taken in El Mulato before and after the electrification, you can visibly notice the difference. Vladimir attributes this to the culture that was brought into the community with the electricity. Now, the children have access to the outside world and more of an opportunity to socialize. These improvements are not unique to El Mulato. Over 100 communities in Cuba have had similar experiences.

With access to outside information, education progressed. The teacher's work was made much easier, and a new school was built. Of the eleven children with learning disabilities, only two remain at lower learning levels. There are now no teenage pregnancies, and less than 40 at-risk alcoholics, with only five serious alcoholism cases.

Use the Sun

Although Vladimir realizes the importance of electrifying the health clinics, he states that he is opposed to using the grid. He points out that using the grid would be more costly. Not only that, but Cuba would be "depending every day on the US blockade." When Vladimir first heard that CUBASOLAR wanted to use the sun to bring electricity to El Mulato, he thought they were crazy. Now he knows that he was the one who was crazy. He believes that Cuba needs to use the sun, wind, and water so that they are independent from the blockade. "When we use solar energy, the blockade can't hurt us energy-wise. By using these resources, the isolated communities will be living much better, and we'll also be helping the world. Even the richest people will be poor if they don't use the sun's energy."

Neighbor to Neighbor: PV

Cuba is also helping its Latin American neighbors. CUBASOLAR recently brought PV-powered health care to Bolivia. La Higuera is the remote Bolivian community where the Latin American revolutionary Che Guevara was murdered in a schoolhouse in 1967. Thanks to CUBASOLAR, the Cuban government, and international support, the school has become a health clinic electrified with PV. The 675 people in this town now have access to good health care, thanks to the vision of their Cuban friends.

PV Vision, Revolution & Reality

Cuba's amazing program to improve the health care in remote communities utilizing PV is much more than just a vision. It's a reality, which is being carried out under extremely harsh conditions. The high indices of health "have been achieved under very difficult circumstances due to the strong pressure put on Cuba by the blockade," according to Pedro Fuentes Padrón, director of the health clinic radio communication systems. "The training of highly qualified doctors and the construction of the family doctor clinics in remote areas of very difficult access show what a true revolution can do."

Access

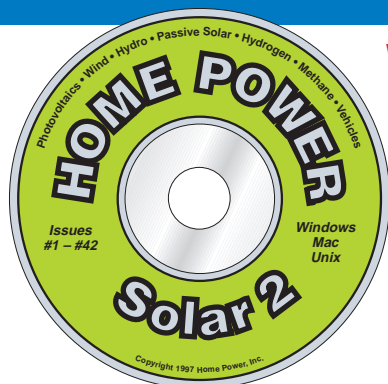
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For information on renewable energy or health care related tours to Cuba, contact: The Reality Tour Program at GLOBAL EXCHANGE, 2017 Mission St. #303, San Francisco, CA 94110 • 415-255-7296
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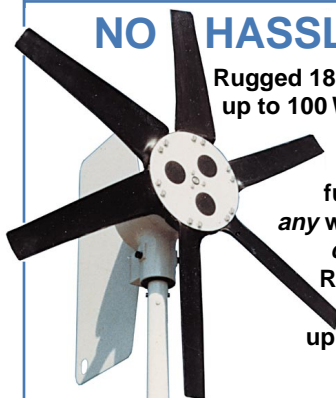
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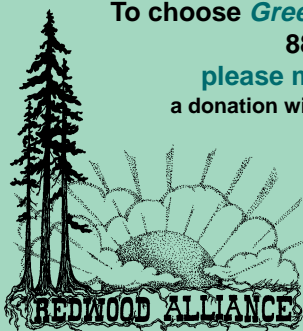
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Solar Cooking in Kenya:

Progress at the Kakuma Refugee Camp

Barbara Knudson, Ph.D. & Mark Aalfs

Photographs by Robert Metcalf, Barbara Knudson, & Bev Bluhm

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Above: Gathering fuelwood requires many hours per week, while damaging stressed ecosystems.

In a remote corner of Kenya at the Kakuma refugee camp, housewives struggling to meet the needs of their families are conducting a remarkable experiment. In a hot and dry region where firewood for cooking is virtually unavailable, they are learning to use the energy of the sun to prepare food for their families.

Solar Cooking

In the last three years, Solar Cookers International (SCI) has introduced over 70,000 people in East Africa to solar cooking. These pilot projects utilize the CookIt, which is a simple and inexpensive cooker made of cardboard and aluminum foil. In a time of diminishing resources while literally half the world's people use fuelwood to cook their food, imagine the possibilities and benefits of widespread solar cooking.

So how did refugee women in Kenya come to apply basic solar principles and experiment with a simple cardboard solar cooker? In a word, need. These refugee women, with very little food and not enough fuel for cooking, were understandably open to alternatives. SCI, working to find people with the most need, offered a powerful solution to these Kenyan women: a new way to cook, using the sun.

Solar Cookers International (SCI)

Established in 1987, SCI is a small non-profit, US-based organization advocating solar cooking worldwide. Originally, the focus of SCI was educational, promoting the potential of solar cooking. During this first phase, the organization developed and disseminated teaching materials to individuals, groups, and schools, enabling people to build and use solar cooking devices.

In the second phase, SCI focused on networking with solar cooking enthusiasts around the world, in a collaborative and global attempt to promote solar cooking. Their most dramatic work, however, has been during the third phase. During this time, field projects have been initiated in Africa to test both the new simple solar cooker and the feasibility of broader use of solar cookers in sunny, fuel-scarce areas.

Solar Cookers

Solar cookers can be traced back to the Swiss scientist de Saussure's wood and glass "bread box" solar cooker in the 1750s. Since then, they have evolved into a variety of focusing, box-type, and hybrid ovens. Solar cookers have effectively cooked food and purified water for decades. Today, a wide range of devices for solar cooking exists, from simple to complex, small to large, and affordable to expensive. For the most part, cookers are either dish-type focusing cookers, box type "collecting" cookers, or hybrids.

The physical principles are quite basic. Solar cookers first focus sunlight onto dark-colored food containers.

Sunlight is then converted into heat on the dark surfaces. The heat is often “trapped” by a transparent material such as glass or plastic, resulting in temperature levels sufficient for cooking food.

CookKit Solar Cooker

The CookKit solar cooker (see diagram) is made from a piece of flat corrugated cardboard approximately 3x4' with reflective foil on one side. The cardboard is scored and folded to make a dish shape. It encloses a black cooking vessel within a heat resistant plastic cooking bag. The reflective panels of the CookKit focus the sunlight on the pot, while the plastic bag traps heat within, increasing the cooking temperature of the food. During field experience, the bag has proven to be the most fragile piece of equipment, needing replacement after about ten uses. It is being replaced by a durable plastic strip, used around the sides of the cooking pot. The CookKit is aimed towards the sun, the cook can go about other business, and when she returns, voila, the food is cooked and ready to eat.

Kakuma Refugee Camp

The Kakuma refugee camp is located in northern Kenya, almost directly on the equator. Some 300 miles southeast lies metropolitan Nairobi, a modern and fast paced city. The camp lies in the bottom of Africa's Great Rift Valley, one of the world's wonders, a place almost moonscape in appearance. Refugee camps are located in settings unsuitable for human habitation. This is obviously the case in overpopulated nations, because people would already have been living there. Kakuma is the temporary home for 40,000 refugees, mostly from neighboring Sudan, Ethiopia and Somalia. These people are living under the protection of the United Nations High Commission for Refugees (UNHCR).

The camp receives less than 10 inches of rainfall per year in relatively predictable seasons, and is sunny the majority of days. Vegetation is sparse, largely along dry streambeds. As the land itself is stony and sandy, no agriculture is possible. For eons, the area supported only a sparse population of hunters and gatherers. These people traveled with the seasons in search of forage for camels and goats, achieving a sustainable but austere balance in this precarious environment.

Minimal Supplies

On arrival, refugees are issued poles to use in building a mud shelter with a blue tarp roof. They are also given minimal household supplies: a blanket, a plastic mat, a nested set of plates and cups in a cooking pot, and a small supply of staple foods. They are given flour, beans, corn meal, cooking oil, sugar and salt—all in amounts calculated to provide 1900 calories per person per day, enough for bare survival. Thereafter, a distribution of food occurs every two weeks.

A small supply of firewood is also provided, since no gathering of fuelwood is feasible in this near-desert setting. This fuelwood is transported to the camp from afar and at great expense to the UNHCR. In the refugees' experience, this supply lasts for less than half of the two-week period between distributions.

Refugees must purchase or barter for the additional fuel they need. Most commonly, wood is gathered at a distance by local tribal people, and processed inefficiently into charcoal. Fossil fuel derivatives such as kerosene are also used. The majority of refugees, without income or incentives, have little choice but to exchange some of their survival level food rations for fuel, since flour, dried beans, and corn meal are of no use in raw form.

Refugees settle into communities of related ethnic groups. Elementary services such as schools, clinics, and sports activities are provided. Small shopping kiosks, coffeehouses, and even simple restaurants have sprung up. Eventually, a kind of temporarily on-hold life is established by most.

Below: A CookKit cooks with the sun





Above: A variety of local foods are solar cooked, including this pasta.

Solar Cooking Workshops

Into this scene, SCI sent a volunteer team to test the feasibility of using solar energy for cooking. The team chose groups of women who were neighbors in each of six zones within the camp. In two-day demonstration and training workshops, seventy-two women were trained and equipped to try solar cooking. Each woman was given a solar cooker (the CookIt), an aluminum pot painted black, two heat resistant plastic bags, and a small supply of food for demonstration and for trials at the workshops and in their homes.

When the solar cooking proved highly satisfactory, the most enthusiastic of the new solar cooks participated with the team in planning additional workshops to be conducted for their neighbors. Sixteen refugee women were trained in participatory educational methods and equipped with kits of training materials and foodstuffs to be cooked. Ultimately, their numbers grew from sixteen to thirty. A simple administrative structure was created, and the women trainers were paid a small stipend.

Success

By the end of 1995, 2000 families in the camp were trained and equipped for solar cooking. By the end of 1997, nearly 6,000 families were taught skills and given equipment to enable them to use the power of the sun to cook their food rations. This was perhaps 80% of the original population, as the camp had, by this time, grown to nearly 45,000. As with any innovation, change does not come easily or quickly. Perhaps this is particularly true when old and valued ways are threatened. However, these women and their families are rational. Clearly, refugees have already been forced

into dramatic changes regarding customs they hold dear.

While difficult to analyze, evaluation after one year suggests that more than half of those trained use the solar cooker weekly, while perhaps 20-25% use the solar cooker every day the sun shines. Solar cooking continues to increase as additional time is spent and experience with the new cookers grows. The amount of fuelwood saved is a matter of controversy. One can argue, however, that any saving of fuelwood in such a fragile environment is valuable and should be encouraged.

Benefits

The women innovators cite a range of reasons for their acceptance of this new and simple to use, though

very different technology. In addition to the obvious fuel saving, the new cookers save physical effort, as they need little watching and no stirring. Except for curious goats and other security concerns, the cookers can be left alone in any sunny spot.

Without flames and high heat, the pot is easier to clean both inside (from gentler cooking) and outside (no black soot from a fire). The absence of cook fires on the ground lessens the danger to small children, particularly toddlers. The food cooks in minimal to no water, resulting in less loss of nutrient value by boiling and

What You Can Do

First, find out more about solar cooking. Call, write, or fax SCI. See the Access section at the end of the article.

Try solar cooking. It works great, and the food tastes wonderful! Your kitchen will be cooler in the summer. If you have air conditioning, you'll reduce bills. You'll conserve our energy resources. It's a great project for kids of all ages. They'll learn the valuable physical principles of heat transfer and light, applicable to a wide variety of human experiences and endeavors.

Join Solar Cookers International. Contact SCI and become a part of this exciting solution.

Volunteer for a project. Through SCI or another organization, spread the word about solar cooking by joining a project.

draining away cooking water. Solar methods are particularly good for food items like beans which require long and slow cooking—and beans are nutritious staples of many refugee diets. Women and their children are free from pervasive smoke, which causes eye infections and respiratory diseases. Water can be pasteurized and made safe for human consumption in the solar cooker, though this is not necessary in Kakuma, which has a safe water supply. Perhaps most importantly, the food tastes good!

Difficulties

The project has met many difficulties, largely logistical in nature. Providing a continuous flow of supplies to this isolated area has been the most persistent problem. Partners on the ground in Kenya frequently failed to maintain the stock of cookers, pots, and plastic bags required to keep training on schedule. As can be expected, political and cultural issues also played a role, but the refugee women have superbly surmounted those. In the face of many difficulties, these women have performed flawlessly as promoters and trainers. SCI continues to work on problems, and has recently hired a staff person located in Kenya to provide logistical assistance to the African sites.



Above: The SCI team promotes learning by doing and prepares local leaders to be solar cooking trainers.

Three More Projects

With variations in ethnic group, environmental setting, climatic circumstances, and partner agencies, three additional projects are underway in Africa. They illustrate a basic principle: solar cooking must be adapted to specific settings to account for variations in food preferences, preparation, climate, weather, family dynamics, and other aspects of culture.

CookKit Plans

The CookKit is typically made of corrugated cardboard with shiny foil laminated to the top side. Draw the cooker to the dimensions indicated and cut around the perimeter. Fold on the lines. Insert tips B and C into slots D and E, respectively.

Use a dark pot around 10 inches in diameter enclosed in a heat resistant plastic bag. Place the pot as indicated by the circle.

Face the cooker towards the sun and tip up the front panel as appropriate for the altitude of the sun.

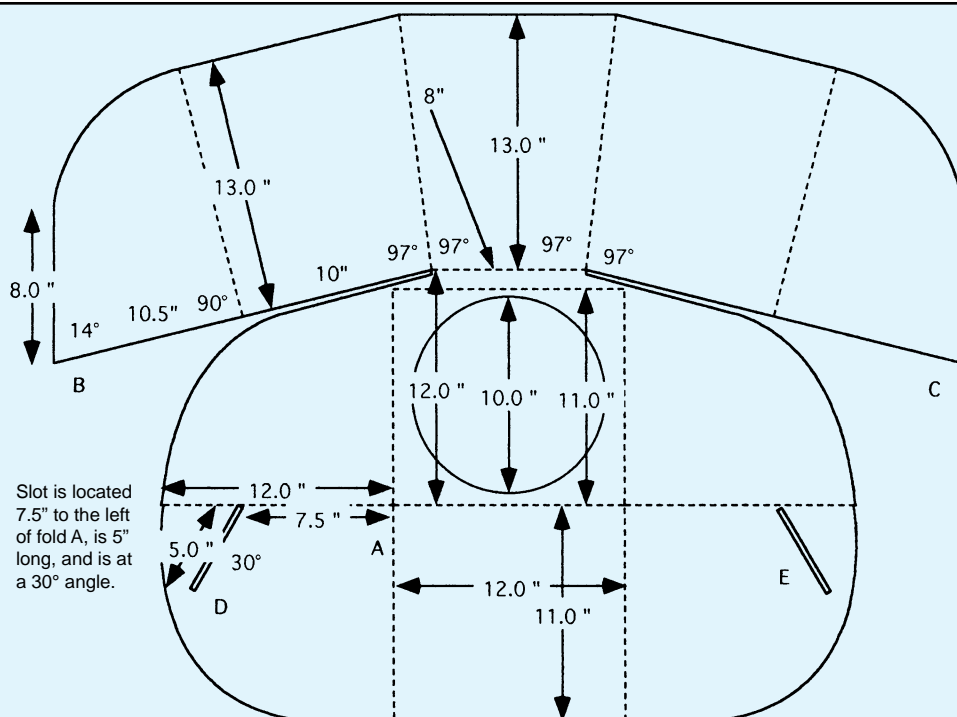


Illustration by Mark Aalfs

Solar Cooking Benefits

Use of free, direct solar energy eliminates the time, expense, environmental degradation, and often danger of gathering firewood.

Use of direct solar energy eliminates a variety of costs associated with finding, collecting, transporting, handling and selling typical fuels.

Solar cookers reduce costs associated with dependence on nonrenewable fuels. Studies in India and Costa Rica find that solar cooking can result in fuel savings of 30 to 50 percent. The cost of replacing cut trees in India is approximately twice the market price of fuelwood.

Reduced fuel subsidies—With solar cookers in use, there is less need for governments to import and subsidize fossil fuels.

Diet—Diets can include nutritious foods requiring hours of cooking such as beans and maize.

Health—No smoke is produced, reducing lung and eye problems. Water-borne diseases kill 50,000 people daily. Solar cookers easily pasteurize milk and water, and can disinfect medical supplies.

Safety—Reduced risk of burns and fires.

Environment—Solar cooking is pollution free.

Energy efficiency—Solar cooking keeps kitchens cooler.

Work and effort saving—Solar cooking requires much less effort than cooking over a fire, freeing women for other activities. Cleaning utensils is easier. The reduced need for collecting firewood results in dramatic savings of women's and children's time and energy, and often results in increased safety.

Women's self esteem—While difficult to quantify, leadership opportunities provide new skills and new self-assurance for women who are actively solving a major community problem by cooking in an inexpensive and efficient manner. Visitors from many parts of the world come to Kakuma to see this project in action, with refugee women as stars of the show.

SCI projects in two other refugee camps in Ethiopia and Kenya and in a settled community in Zimbabwe use variants of the method described. However, all of these projects are based on the principles of active participation of the women themselves and of active and participatory learning methods. Women learn about solar cooking by doing it. In one-day workshops, they make their own lunch and take food home to their families for the evening meal. Training materials are entirely visual. No words are used, to surmount problems of language, and more importantly, illiteracy.

Solutions

In a world threatened by hunger, deforestation, and growing populations spending larger proportions of small incomes on cooking fuel, solar cooking is a powerful solution. Where women and children walk ever farther to gather wood, sunlight can surely save precious human energy for other pursuits.

The mission of SCI is to spread solar cooking to benefit people and environments worldwide. The field projects demonstrate that women, trained and equipped, will readily accept and use this radically different technology, where climate permits and fuelwood is scarce or expensive.

Slow Progress

SCI is the global focal point for promotion of solar cooking technology. Estimates are that several million people worldwide cook with sunlight, the greatest numbers being in China and India. Even with these large numbers, SCI recognizes that in terms of impacting public policy at national and global levels, little progress has been made. One of the key factors has been the historical availability of firewood. In fact, half the world still cooks with wood. However, even the most casual observer can see that wood is rapidly disappearing. A striking fact is that the planet's human to wood biomass ratio is rapidly increasing. With each passing minute, there are 200 more people on earth and 50 acres less forest.

Each of the nearly six billion of us on earth would like to eat cooked food every day. Using the free power of the sun to accomplish this purpose, whenever and wherever possible, is an idea we must pursue. Kakuma housewives are doing just that, and are pleased to share their successful experiment with the world.

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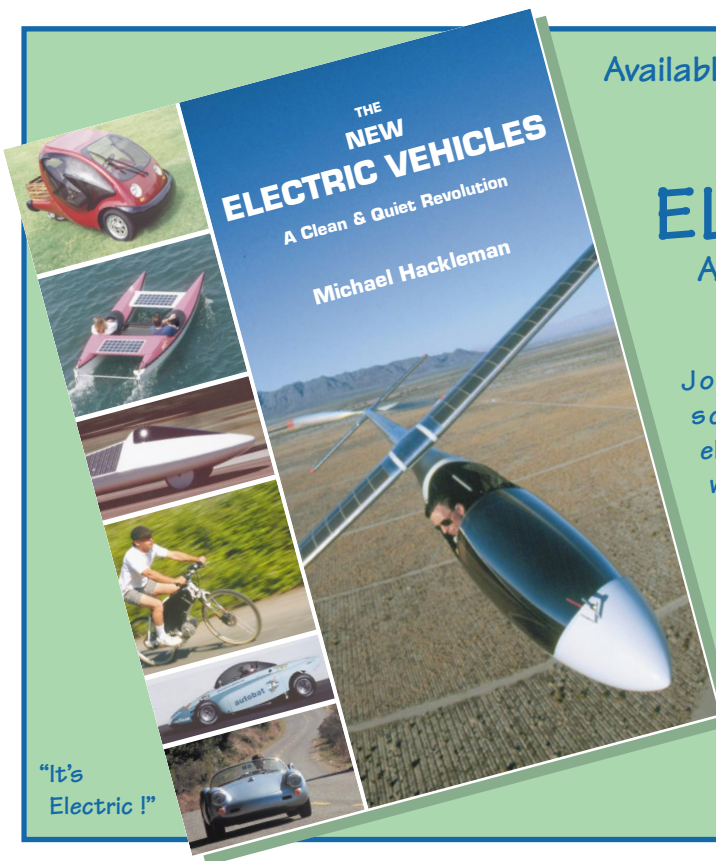
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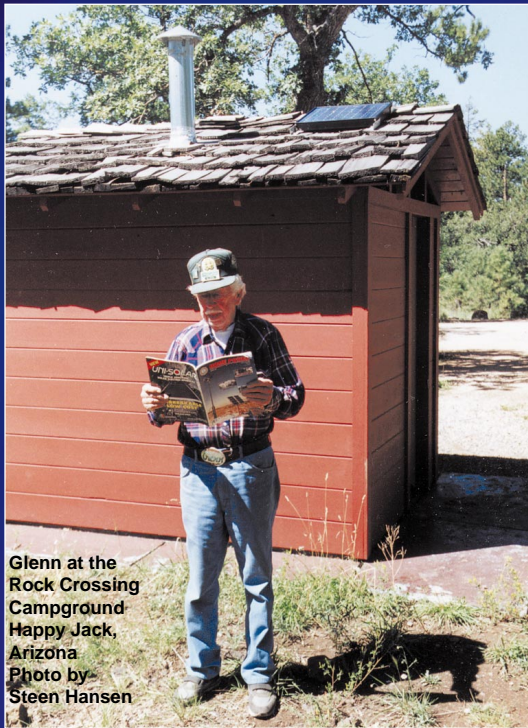
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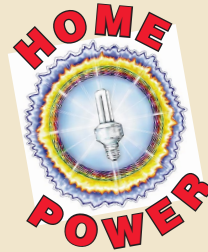
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There are many questions new owners of electric vehicles face regarding insurance. How does one go about getting it? Are the rates higher? Lower? Is it available at all?

With a little bit of effort, the answers to the last three questions are yes, yes, and yes.

An informal survey on the internet about EV insurance experiences brought a variety of responses. Gardner H. wrote, "I had no problem getting insurance for either the EV1 or the Ford Escort conversion thru 20th Century Insurance Company. However, I was turned down flat by Farmers simply because the cars were electric." Mark B. responded, "I have had Farmers Insurance for my Ford Escort EV since the month I bought it."

Some EV owners have successfully insured their cars through various other companies, and a few have been flatly stonewalled. Some have been able to get liability, but not comprehensive and collision.

So, What's the Deal?

The deal is that EVs have not yet made a blip on the insurance industry's radar screen. According to the Insurance Information Institute, a sampling of major insurance providers indicates that they have not yet formed any specific policies about insuring EVs

because there are so few of them on the road. In this dearth of corporate guidelines, agents are left to try and fit EVs into existing insurance pigeonholes. Sometimes it works, sometimes it doesn't.

Liability Coverage

First, we need to separate liability insurance from comprehensive and collision. There should not be any problem getting liability insurance simply because the vehicle is electric. Liability insurance is based primarily on the driver's demographics and driving record.

However, the type of vehicle can still play a part. Sport/utility vehicles, for example, have been shown to cause more damages and injuries to other cars in accidents, so some companies have raised the liability premiums for these vehicles. Similarly, a high-performance sports car might have higher liability premiums than an econobox.

Conversely, Scott C. found the liability rate for his electric Ghia to be lower than for his gas car, because his agent considered it a low mileage recreational-use vehicle.

Insurance companies have had too little experience with EVs to have any specific liability rates for them. A representative from Farmers Insurance said that she expected to see EV insurance rates drop once a database has been established, because EV drivers are expected to be more careful than most drivers.

Honda includes comprehensive and collision coverage in its lease for the EV Plus. This caused a slight hitch for Andy S. when he tried to get liability insurance from Allstate. The computer required leased vehicles to have comprehensive and collision coverage as well as liability. The owner had to get a statement from the Honda dealer verifying that this coverage was already included in the lease before he could get his liability coverage.

Andy has three cars insured with Allstate. Interestingly, the EV Plus has the lowest rate for liability coverage. The Ford Escort electric conversion has the next highest rate, followed by the gas-powered '86 Toyota Camry.



Above: Volkswagen or Voltswagen? Your Insurance cares.

Safety First

Some companies, like the American Automobile Association (AAA), require an inspection of modified vehicles before they can be insured. AAA requires a "quality and safety inspection" even for liability coverage.

If your EV was converted commercially, you probably won't have a problem. If it was done privately, then workmanship will be important. An inspector who sees a rundown-looking chassis, dirty batteries, a rat's nest of wires and big wads of electrical tape will probably not look favorably on your application.

The things they will look for will be clean, professional-looking wiring, securely contained batteries, and a car that sits and rides straight and level. Any modifications to load-bearing structures will be examined closely. If the car had power brakes before modification, it had better still have them as an EV.

If you can show that the conversion was done with careful thought, that will weigh in your favor. Evidence of improved brakes and suspension will also help.

Comprehending Comp & Collision

Comprehensive and collision (C&C) is where the fun starts. This is the insurance that covers damage to the car itself. Insurance companies base these rates on formulas that include many factors, such as market appeal and typical repair costs for each model. The accumulated information used to calculate the formulas is stored in databases.

Many companies subscribe to the Insurance Services Office (ISO), which provides ratings symbols for all

makes and models of cars. These symbols take into account all of the various factors that determine premiums, and place a car into a particular category for rates. The ISO will need more time to build a database on EVs before it can assign a ratings symbol. This symbol will then be available to all its subscribing insurance companies.

When a model is too new, companies may "borrow" a rating temporarily from a similar model. For example, when the VW Corrado was introduced, AAA based its rates on numbers for the earlier Scirocco.

If there is no similar vehicle, the insurance companies fall back on a formula using the manufacturer's suggested retail price (MSRP). This is the current situation for cars like the GM EV1 and the Honda EV Plus. This creates a temporary discrepancy in rates. Neither of these cars is available for actual purchase, but each has a hypothetical MSRP, which is rather pricey. This means that C&C premiums are correspondingly high.

As the Farmers spokeswoman put it, the cars are priced like luxury cars, but used like commuter or pleasure vehicles. As the insurance companies develop track records for these vehicles, the rates should drop.

The two production EVs most widely known to private owners today are the EV1 and the EV Plus. These cars are both available by lease only, and full insurance coverage is required before the car can be delivered to the customer. In the case of the EV Plus, the C&C portion of the insurance is included in the lease. A sampling of dealers didn't turn up any reports of customers having difficulty getting insurance for these

vehicles. Of course, since these cars come from major manufacturers, the insurance companies have procedures for dealing with them, even without a history for the model.

Conversions

The most difficult insurance to obtain is C&C for a home-built conversion. The problem is that the converted vehicle is worth much more than an unconverted car of the same year and model. Agents do not have a ready reference for how to value the car, or how to set the premiums.

Although it will take some effort, insurance should be obtainable. As a spokeswoman from AAA said, "If the Motor Vehicle Department will give the car registration, it's pretty hard for us to turn it down for insurance."

You might improve your odds by going with a company that is strong in the same geographic areas where EVs are most prevalent. For example, the EV1 was first released in Arizona and California. A representative of SAFECO said that his company anticipates having a growing number of EVs on the books because California and Arizona are large markets for SAFECO.

An inspection is almost a certainty. Companies vary on how they establish a value. Some will accept the value of the car before conversion, plus the cost of the conversion components, as proved by receipts. Andy S. covered his Escort this way with Allstate. The book value on the car is \$7,000, but it's insured for \$12,000. Some companies want an appraisal from an expert in the EV industry. This expert may also be the seller of the conversion kit.

Farmers has a policy for any kind of modified vehicle, which includes EVs. If the modifications increase the value of the vehicle by less than 50%, the normal premium rate applies. If the value is increased by more than 50%, there is a 50% modified vehicle surcharge on the premium.

Sometimes a conversion can increase the value of a car by as much as 1000% or more if the donor vehicle was an older model. In extreme cases like this, or in cases where the agent feels that modifications to the original chassis were "significant", they may call in an underwriter for special review of the case.

Permission or Forgiveness?

In the past, some EV drivers have chosen not to tell their insurance agents that the car was electric, for fear of getting turned down. But what happens if you have to make a claim?

Most insurance companies indicated that they would not cancel the driver's insurance and that they would pay the claim. However, there were a couple of

stipulations involved. Once the company becomes aware that the car is electric, particularly after a claim, a safety inspection of the vehicle is required. If the vehicle does not pass, the company might choose to exclude it from further coverage even though the owner can still continue coverage on any other vehicles.

What does it take to pass this safety inspection? There aren't any hard-and-fast standards. It boils down to the inspector's educated opinion as to whether the conversion process made the vehicle unsafe. Again, the more professional the workmanship, the better the chances are for getting approval.

The second stipulation is that the company will pay any C&C claims based on the value for which the car was insured. For example, if an EV was insured as a 1984 gas Rabbit, then the company will pay a claim based on the value of a 1984 gas Rabbit, which is considerably less than the value of a converted electric Rabbit.

In short, if your agent doesn't know the electric nature of your car, you are okay for liability claims, but may find yourself drastically under insured for C&C. Of course, most people don't bother getting C&C on an older car, so if you ask for it, your agent is likely to quiz you.

The Bottom Line

When you sort it all out, it means that, yes, you can get insurance, even full coverage, on your electric vehicle. The premiums might be a little high on an EV1 or EV Plus, but since they are lease cars, you really don't have a choice. For conversions, you are best served by being up front with your agent, to be sure that you have the coverage you really need.

Some people discovered that, even with cooperative agents, their policies arrived showing the car as gas-powered. Most often, there was a simple glitch further up the insurance food chain, or an obstinate computer. Be sure to check your policy and make sure it's correct when it arrives.

If an agent turns you down right off the bat, one of two things is going on. The agent may believe he can't insure the car because he can't find anything about it in his books. Tell him to talk to his underwriters, and they should straighten it out.

The other possibility is that the agent simply doesn't want to do it. He may not want to put in the extra effort, or he may be personally anti-EV. In that case, take your business to someone who wants it.

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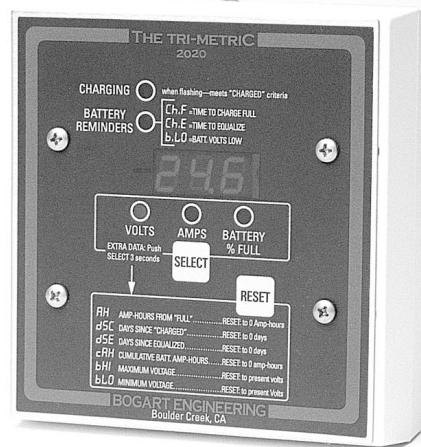
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Why bring back the PV bulk buy? The first bulk buyers lived off-grid. They wanted to go solar, but for many people PV cost more than utility line extensions or fossil fuel generators. Bulk buy prices made the difference and thousands of people turned on to PV.

Today, a lot of people connected to the grid want to go solar, but PV kilowatt hours cost more than grid energy. Lower cost modules can make the difference because the modules are about half the system cost. Now is the time for grid connect PV bulk buys.

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Let's get together and buy a megawatt or two. If you are ready to buy PV now, send a self-addressed stamped envelope to: Joel Davidson, SOLutions in Solar Electricity, P. O. Box 5089, Culver City, CA 90231 or call Toll Free 1-877-OK SOLAR (877-657-6527)





Mike Brown

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“Can I charge my electric car with solar panels?”

Solar power is to electric vehicles like fries are to burgers. People refer to EVs as solar electric cars. The only true solar electric cars are the ultralights that run in the Sunrayce in this country and in the World Solar Challenge in Australia. People ask, “Why can’t you put solar panels on the roof of a car to keep the batteries charged?” Unfortunately, there is not enough roof area on the average EV to mount enough solar cells to do any good. Reality changes the focus to, “Could you use a stationary solar array to charge an EV?” Answering that question is the topic of this column.

The practicality of charging your EV with solar panels is dependent upon many factors. The most important questions to ask are: “How is the EV used?” and “When is it going to be charged?”

In the ideal scenario, the EV would be used early in the day. It would consume half (or less than half) of the charge in the batteries. With this type of use, an appropriate solar array could charge the batteries directly, and the EV could be driven daily. If more of the battery capacity were used later in the day, the charging could be started that day and finished the next. With this plan, there is a chance that the batteries might not be charged enough to allow use of the EV the second day. Also, leaving the batteries partially discharged overnight could be harmful in the long run.

If the car is like most EVs and spends all day away from home base while being driven close to its maximum range, then charging overnight is necessary. This is where things get expensive and complicated. For a battery-to-battery charging system, you will need a stationary battery pack, charge controllers for both the stationary pack and the EV, and a solar tracker panel rack to get the most sun to the panels. All of this is in addition to the solar array itself. If you are going to use a standard ac-powered EV battery charger, you will need to add a heavy-duty inverter. Since the

ability to charge the EV affects your mobility, a suitably sized gen set should be included in the system for cloudy days.

With the system described above, the stationary battery pack will be charged during the day while the EV is being used away from home base. When the EV comes home at night, it is charged either directly from the stationary pack or from its built-in ac charger through the inverter. This is the equivalent of a system for a large home in the 13 kWh per day range and costs around \$28,000.

If you are in the position to use a grid-intertied system, you could eliminate the stationary battery pack. This would be effective only if you got credit for the electricity you produced during the day to off-set the cost of the electricity used at night to charge the EV. This is the system that the Sacramento Municipal Utility District uses to solar charge their EV fleet.

As you can see, solar charging an EV would take a commitment of time, money, and personal energy equal to or greater than the decision to drive an EV. That is not to say that it can’t or isn’t being done. While researching this column, I talked to several individuals who are doing it. They all have their own unique circumstances that allow them to solar charge, and reasons for doing it. The bottom line is: examine your mission for the EV, your lifestyle, and your budget, then use the resources of this magazine to design a system that suits these factors.

Please contact me with feedback, questions, or EV technical problems.

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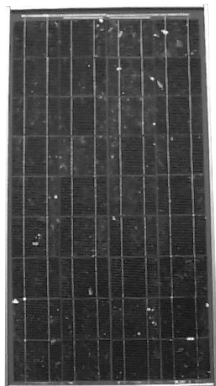


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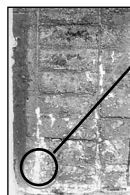
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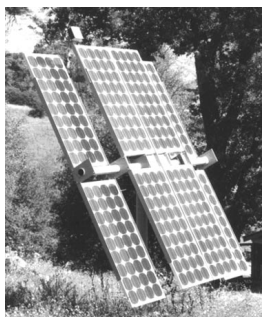
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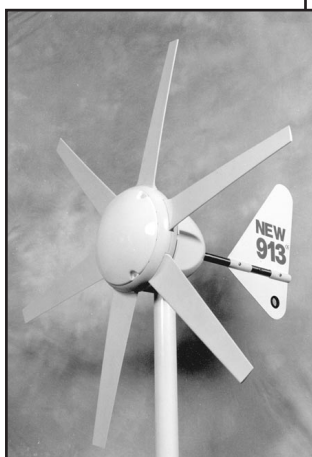
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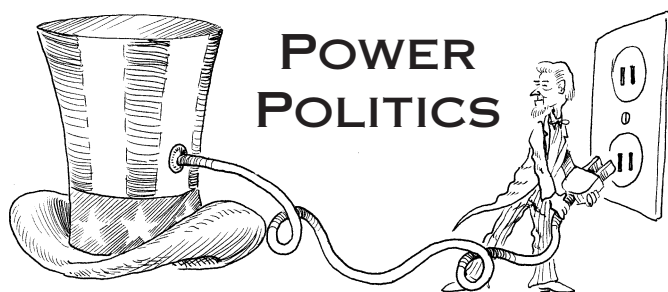
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Nader at MREF

Michael Welch

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Ralph Nader was keynote speaker at this year's Midwest Renewable Energy Fair. They couldn't have chosen a more appropriate speaker. He is one of my heroes.

I'm sure he cost a lot of money to hire, but if everyone enjoyed him as much as I did, it was a bargain. When he was introduced to the crowd, nearly everyone popped out of their seats, full of respect and admiration. He has done more for renewable energy and other consumer/environmental interests than anyone else who comes to mind. When he finished his presentation, the crowd reacted even more enthusiastically with a full standing ovation.



Commonwealth

His message reached a wide audience, many from "Middle America" who had not heard it before. His skill in delivery was unmatched by previous MREF speakers. It was also backed by a wide base of intelligence and knowledge, and with enough credibility to reach even the dubious in the crowd.

Maybe everyone got something a little different out of the talk. He certainly covered a lot of territory. He spanned everything from the environment to social problems, from labor to health, to the problem of the concentration of wealth. What I got out of it had a central theme: that which has been taken away from us, or denied to us, for the sake of corporate profits.

Not only in my own opinion, but for others on the HP Crew as well, one particular point really stuck out. Nader spent a few minutes on the question, "What do we own?" When asked, most US citizens mention their car, home, clothes, bank account, and other immediate possessions. Ralph points out that the one thing people rarely mention are the vast holdings that "We the People" own, since we are all part of this nation and society.

These vast holdings are called the Commonwealth. As citizens and taxpayers, we hold the rights to millions of acres of land (it is not a bad thing that the government owns land, it just means that it is ours together). For now, I set aside the haunting problem that most governments, including our own, gained land by stealing it from others. As citizens of this country, we also hold the rights to vast amounts of information and intellectual property gathered on our behalf, for our use, and paid for by our tax dollars. Ralph also pointed out that we "own" the broadcast frequencies that the media uses to numb our minds.

The corporations also view these common assets of ours as being theirs. Actually, they don't really care who these assets belong to, as long as they have free access to profit from them. They take the resources, and we foot the bill. Corporations have amassed so much political power in our society that most of our Commonwealth has become theirs for the asking.

One example is the forest industry that logs our public lands. Our government charges them small fees that don't even cover the cost of building logging roads that the private companies use to get the fallen trees out. Taxpayers pay for the roads, so timber companies can roll in the dough.

Keep It Ours!

When was the last time you (or a friend) visited your senator and said, "Pat (substitute your senator's name), I would really like it if we kept the lands surrounding

Yellowstone National Park in a natural state, so that my children's children will be able to see nature at it's best." Or, "Pat, please start spending more of the tax money we give you for research and development towards a renewable energy future." Or, "Pat, some of these new drug treatments that the government is developing and testing should be made directly available to the people at a reasonable cost."

The reality is that those people with this kind of influence over our representatives are hired by the big corporations and the industry groups that represent them. They have legions of full-time, highly paid lobbyists, while an individual citizen is too busy eking out a living to travel to Washington to make an important point. The future of our Commonwealth and government is left in the hands of people who are paid big bucks to specifically void citizen control. Our public property is then abused by those who care for nothing but greedily lining their pockets from our birthright.

When corporate minions visit Senator Pat, they say, "We want to drill for oil in the public lands surrounding Yellowstone Park." Or, "Enough solar, Pat, we need to continue investing government funds in nuclear power research so that our company can sell reactors to Korea since Americans won't put up with them anymore." Or, "Hurry and finish testing that new HIV drug, America, we want exclusive rights to it so we can sell the treatment for \$30,000 a year." And they all finish with, "What's good for commerce is good for America."

Who Owns Senator Pat?

Ralph says that our politicians are bought and paid for by corporate America. Think about it. When was the last time you saw a successful grassroots election campaign? Quite a while ago. Even local politicians in my area tripled the amount of money they spent on campaigns since the last election. Where do most campaign funds come from? Corporate America, and it doesn't much matter whether the candidate is Democrat or Republican, both get about the same amount of money and the corporations get about the same amount of influence.

Even if corporate campaign funding and influence wasn't as big of an issue as it really is, take a close look at who controls the major media. Every major TV network is owned by a large corporation that has interests other than that media. Do you think corporations buy up the networks to make sure we get quality programming? No, they do it because the TV media is a very effective mind control drug. People watching TV become numbed toward making effective change, and think themselves unable to make a difference. At the same time, they are bombarded with psychologically designed ads that make them think they

want to consume more and more. In other words, our air waves (part of our own Commonwealth) are being used against us to make corporate shareholders and executives obscenely wealthy.

As Ralph says, the media sound bite is king. It helps to keep the citizen's real needs at bay. The corporate bad guys tell us over and over via their purchased ads and "expert" talking heads that "Solar may work some day, but is not cost effective now" and (formerly) "nuclear power is too cheap to meter" and (currently) "nuclear power is a clean technology that doesn't produce greenhouse gases." In the meantime, the only way to counter their repetitive bull pucky is by explanation, and that's the catch: major media won't let us offer full explanations, they want it in nice, neat, 5 second sound bites. Try to explain your off-grid home power system to someone in 5 seconds or less. It can't be done.

Is Government Bad?

Readers have gotten on my case before about my beating up on corporations (the poor things). I'm sorry, but they are the bad guys, and I need to tell it like it is. I'll stick my neck out a little further by stating that government is not a bad thing. Of course, there are always exceptions like dictatorships, where only one person (or a few people) have any meaningful say. Within the realm of possibility, our elected government may be the best system. I believe that there will always be some kind of top-down leadership in any organization, and a nation or expanse of inhabited land is no exception. I have friends and co-workers who are firm believers in anarchy as an answer, but I have never seen it happen. There will always end up being some kind of top-down hierarchy to deal with.

A democratically elected form of government, e.g., in the US and in some other countries, may be about as close as one can come to responsive leadership. However, democratic governments are not without problems. Don't forget, no government is any better than what controls it. Over the last few decades, corporations have used their vast financial resources to influence elections, elected officials, and the regulators they appoint. At the same time, this discourages citizens by making them feel powerless. We are losing control of our government to big business.

Are There any Solutions?

First, if I've told you once, I've told you a dozen times: *institute campaign finance reform*. We need to take the big money out of elections. How can we elect viable candidates if the good guys can't afford to run against the ones supported by big \$\$\$?

Second, *use the citizen initiative process* to institute changes in your state, when your representatives

become unresponsive to your needs. If your state does not allow citizens to gather signatures to place potential laws on ballots, then work to add the initiative process to your state constitution.

Next, *search out and support local groups* that are beginning to work on the big picture of corporate accountability. They are not like environmental groups or social change groups that constantly stick their fingers in the dikes of a system going bad. These new groups are working on a larger picture: ending corporate control of our lives so that government and media can be responsive to the needs of the people.

Corporate Charters

Here's how these new community organizations work. Every corporation works within the confines of individual state laws that grant them their charters to do business. Those laws give states the right to control what corporations can do and how large they can become. If a corporation acts improperly, it can be dissolved by revoking its charter.

The ultimate goal of these new citizen groups is to be able to revoke the charters of misbehaving companies. However, they recognize that there is a huge job to be done before that can happen. A lot of education and empowerment has to occur before people will be ready to make their state governments effectively regulate corporations.

There have been corporate charter revocations in the past, but this hasn't happened in the last hundred years. It is time that we took this important tool back, and put it to use.

We will have to completely change our way of thinking to realize and then enforce the fact that corporations were really designed and founded strictly for the good of the people, not to become megalithic, self-sustaining destroyers of the world. Groups will need to continue sticking their fingers in the dikes until our citizenship can finally come around to dealing with the root cause of the problem: ill-behaved corporations.

Can we stop talking about Y2K yet?

OK, I bow to what the readers want, Y2K info. Thanks to Richard Perez for this great concept: Install a solar electric system. That way, if the grid does go down, you'll have electricity. If the grid doesn't go down, you'll have electricity. Simple enough? See page 6 of this issue.

Access

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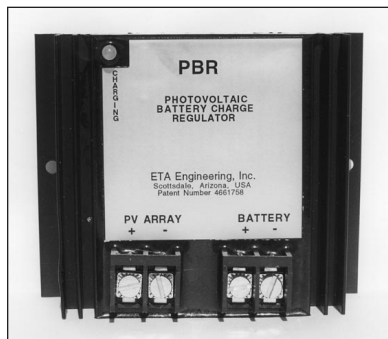
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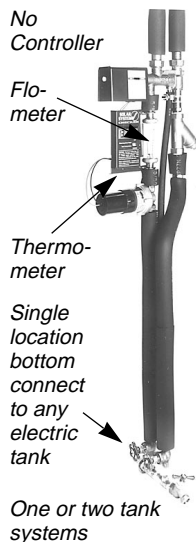
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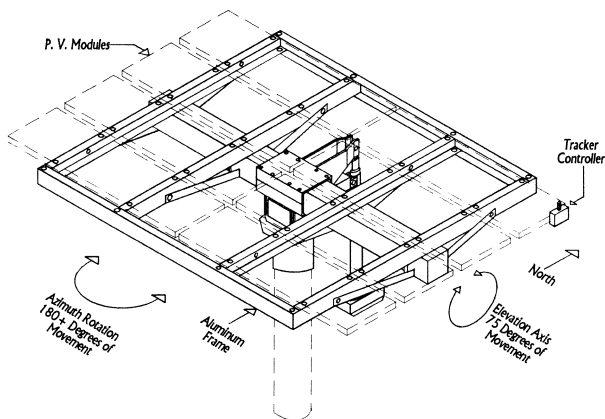
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IPP members who have E-mail were alerted in May about a pending filing. Public Service Company of Colorado (PSC), an Investor Owned Utility (IOU), was proposing to market and install PV systems. Not only is this a hot issue with IPP, but members of Colorado Solar Energy Industries Association (CoSEIA) were also alarmed.

Three Major Problems

PSC's filing before the Public Utilities Commission was seriously flawed on a number of counts. First, a regulated monopoly cannot extend its monopolistic franchise into a competitive environment. In this case, the sales and installation of PV systems. Second, an IOU cannot use ratepayer funding to finance such activities. PSC was planning to rate-base the administration, metering, and monitoring costs of the program. Third, PSC would be engaged in anti-competitive market abuse.

The Plot Thickens

Action on the part of CoSEIA, Bill Schroer of Energy Advocacy, Colorado IPP members, SEIA and Colorado environmental groups resulted in a limited modification of this turkey of a program. When faced with coordinated, organized and coherent opposition, PSC initially declared that they would withdraw the application. The inner workings of what followed are not clear to me. However, I sense that as the forces of compromise (otherwise known as SEIA) prevailed, IPP's point of view became unwelcome. The end result was that an uncontested application with stipulations was presented to the Colorado Public Utilities Commission (PUC) on June 19.

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Of the three major problems cited above, the stipulations corrected only one. In the stipulated filing, PSC will offer a net metering tariff and inform prospective customers via a bill stuffer that a limited number of low cost PV systems are for sale from a third party vendor. PSC will not be selling or installing PV systems. When interested customers contact the third party, they will be provided with a list of qualified PV installers. Interested customers will purchase the PV system from the third party and contract with an independent for the

installation. Qualified contractors will be listed with the third party, including Photovoltaic Services Network (PSN).

PSN is funded by UPVG, which in turn is funded by the U.S. Department of Energy (DOE). The purpose of PSN is to short circuit the normal distribution network of the PV industry and to provide a direct connection—manufacturer to utility to customer. It is interesting to note that only two weeks ago, PSN was a non-profit organization. Now, they are a full-profit energy services company.

The second and third problems remain. PSC will continue to rate-base the administration, gather information, and analyze the program. PSN, as a utility surrogate, now assumes the monopoly of discounted PV systems.

IPP is critical of publicly funded programs that damage or ignore the role of the entrepreneur in the process of delivering PV technology and service. In the program just cited, the local PV company will get the installation and service (labor only) but will be disconnected from the design and sales part of the job. The utility and their surrogate (PSN) have come between the customer and the competitive PV service company. For an "orderly" commercialization of PV, the infrastructure must be developed along with sales volume. This could easily be done by putting the rebate in the hands of the consumer rather than in the pockets of the manufacturer or utility.

Thanks to Lotus, President of Rocky Mountain Solar, Inc., for contributing the following CoSEIA Member's perspective in *CoSEIA Duped & Members Lose Big Time*.

IPP on the Road

We had an informational booth at the Midwest Renewable Energy Fair. Our banner, donated by Energy Outfitters, reads: "Renewable Energy, Locally Owned, Locally Produced". Thanks to Christopher LaForge of Great Northern Solar for organizing the display. The IPP banner is available to all members for display at shows. IPP will UPS the banner and handout information. Let us know a few weeks before your event. Next stop, Tehachapi Wind Fair, Tehachapi, California, July 18 and 19.

Access

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CoSEIA Duped & Members Lose Big-Time

Lotus

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On the surface, it may appear that my trade association, CoSEIA, won-big time in the settlement with PSC. In fact, this is just what an insert in our CoSEIA newsletter asserted just the other day. Remember, PSC is a large regulated electric utility monopoly.

I know that some very hard working people put together this settlement, mostly on a volunteer basis. I appreciate their hard work. However, my opinion is that most of the CoSEIA Members are losing big-time, and that in some ways, CoSEIA seems to have been duped.

Here's The Catch

Let's assume that the Public Utilities Commission (PUC) accepts this settlement. If we only focus on PSC and the settlement, then it does appear that PSC, as a regulated utility, will not sell and install PV systems. We can also see that customers will be provided with a list of authorized PV dealers.

At least PSC, as a regulated utility, is not going to be directly competing with the unregulated, highly competitive, mostly small, current PV dealers. That's all well and great, but here's the catch—PSC can create a company that is not regulated and that can directly compete with us little guys, as long as it does so without using rate-payer subsidies.

Funded By You and Me

On a national level, the utilities have already done this by creating Photovoltaic Services Network (PSN). Utility Photovoltaic Group (UPVG), an umbrella group of mostly utilities, provided funding for PSN. Located in Lakewood, Colorado, PSN was funded primarily with large chunks of federal money. Yeah, *our money*. Just recently, the DOE gave PSN \$700,000. PSN mainly has utilities among its members; and these members pay money into PSN. Apparently, the utilities and the U.S. Government believe that money to promote solar electricity should mostly go to the giant utility monopolies, rather than to the end users in a free market.

Sneaky Spotlight

Our latest CoSEIA newsletter even had a feature "Spotlight" article on PSN. It happened to be written by PSN, and was very favorable to PSN. There was nothing in the article about the relationship between PSN and the utilities, except for the mention that PSN recently signed a contract with PSC to be their local energy service provider. The article also states that PSN will use the \$700,000 to "help electric utilities throughout the nation establish residential and commercial solar energy...programs".

So, PSN is a CoSEIA member. I was thumbing through my CoSEIA Membership Directory and it contains a full page ad from guess who—PSN. The ad says that PSN does grid-intertied systems, off-grid power, water pumping and outdoor lighting. With all that money wouldn't you know it—the ad says that PSN has the highest quality systems at the lowest prices! Apparently, this little multi-million dollar utility surrogate "has formed alliances with many of the industry's key manufacturers". Most certainly, PSN does have an 800 number. I wish my company could afford an 800 number!

No Free Lunch

My company was never spotlighted with a free and very favorable 2/3 page article. But then, my company was not created by the utility companies and money from the U.S. Government to be the Trojan Horse that is about to put the little solar companies across Colorado and the U.S. out of business. Those little struggling companies soon to go down the tubes are the same ones that created the current solar electric market that PSN is setting itself up to take over.

My little company was created by many years of very long hours and a lot of hard work. There have been no utility or government handouts direct to my company—none

whatsoever! Now, my own trade association is so naive and wimpy that it is trying to tell me that "CoSEIA Wins Big" in this settlement with PSC.

Don't Give Up

I do not care if the giant corporations have rigged the political game and the laws so that PSN is legal. I do not want to hear the leaders in CoSEIA tell me about how big and unbeatable the utilities are, here in Colorado, or California, or nationally. I do not want my trade association to just sit back and accept the fact that the Security and Exchange Commission acts like it is regulated by the utilities rather than the reverse.

If the anti-nuclear power plant movement (of which I was an active participant for many years) had been as naive and wimpy as I think CoSEIA is today, then the anti-nuclear movement would have said, "But nobody believes us when we try to tell them that these plants are dangerous; the military, the U.S. Government, the giant corporations, the media and the public are all in support of nuclear power plants." If the anti-nuclear movement had been wimpy and naive, then it would have given up and let hundreds more nuclear power plants be built. No, you do not just give up and let the corporations have their way, nor do you allow them to push their Trojan Horse right into your state—eventually into your city, or town.

PUHCA Threatened

During the 1920's, the utilities had become so monopolistic, powerful, and inflated prices to such a degree that the Public Utility Holding Company Act (PUHCA) was passed to protect consumers by restraining utilities from market dominance. The utilities are currently attempting to have this act repealed. PUHCA is also supposed to make it difficult for utilities to own or establish non-utility businesses (like PSN), preventing the largest and most aggressive monopolies from engaging in the subsidized destruction of thousands of small businesses (such as heating and air conditioning contractors, appliance dealers, appliance repair, and solar contractors).

Educate, Protest & Change the Law

Currently, there is probably no way to legally prevent PSN from eventually offering solar thermal and space heating systems in addition to solar electric. Rather than accepting the status quo and watching PSN grow, spread into more and more parts of Colorado and the nation, and eventually destroy the smaller solar companies, I suggest an alternative.

I propose that CoSEIA join with other organizations and trade associations, educate the public and the politicians, protest, and change the laws. Public Citizen, the organization founded by Ralph Nader, is in the process of writing federal legislation that would do more to protect small businesses from unfair competition from utilities. Public Citizen is neither naive nor wimpy. CoSEIA needs to work with and encourage organizations like Public Citizen.

Goodbye, PSN

I also strongly propose that CoSEIA give back PSN its membership dues and that PSN be removed from CoSEIA. Something similar needs to be done within my national trade association, the Solar Energy Industries Association (SEIA). Currently, Wayne Gould is both on the Board of Directors of

Independent Power Providers

Southern California Edison and chairman of SEIA's utility council. I see no reason why my CoSEIA and SEIA membership money (and my federal tax money) should be used to promote the interests of giant monopoly corporations and their corporate fronts, while at the same time destroying my little solar business, and others like it.

PSN (and corporations which are similar to PSN) should be made illegal and dissolved. The federal money that PSN currently has should be given to the end users, to the consumers. Let the consumer choose the company, in a free market, non-dominated by giant monopolies.

CoSEIA may have won a few concessions from PSC. However, those stipulations do very little to mitigate the extreme advantages that the utility monopolies and the US Government have given to PSN. If PSN is allowed to continue to out-advertise my company, undercut my prices and put me out of business, I will remember the words of *my* trade association, CoSEIA, "CoSEIA Wins Big..."

Access

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PSN Responds

Terry Schuyler

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Thanks for an opportunity to express our concerns regarding the proposed article by Don & Lotus. As I have mentioned on the phone, we welcome healthy debate on differing philosophies regarding commercializing PV.

The above articles have been premised on perceptions that were based on incorrect facts. The following facts may help to clarify who the PSN is, how we were created, and how we choose to do business as a PV company.

PSN is a privately held LLC corporation with no utility ownership or investment.

PSN is in fact a relatively small company of 7 employees (50 yrs combined PV experience however) and not some multimillion dollar Goliath. PSN is not funded by DOE (i.e. not a DOE or utility shell or surrogate) but has applied for and received a competitive UPVG TEAMUP award to help commercialize PV through Million Solar Roofs initiatives. These TEAMUP awards are effectively contracts for specific work performed (through a contracted delivery schedule) and this funding program was made available to all PV companies that wished to apply. PSN does provide its services to builders, developers, government agencies, non-profits, individual consumers and utilities. PSN also provides local contractors access to its DOE funding by selling the subsidized systems to them for their own resale and local implementation. PSN finds it to our advantage as a private energy service company to work with utilities to provide outsourced PV services. This is our approach to what we believe will be a successful PV industry company. PSCO is undertaking a PUC tariff to provide public education to consumers on the benefits of PV systems and through a rate payer based net metering program. However, PSCO cannot

offer a product through this education campaign; any product offering must be done through their non-regulated subsidiary.

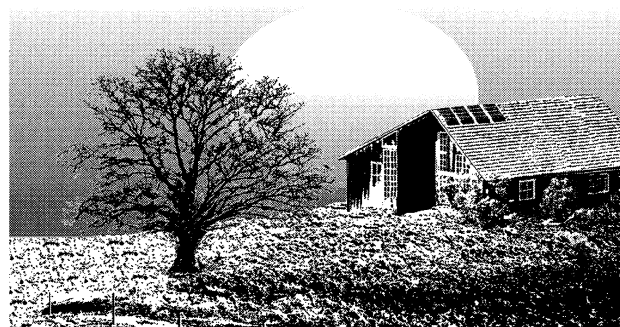
PSN will be working with PSCO in Colorado to provide PV services as a non-regulated utility product offering. PSN is covering all costs associated with marketing and billing and working collaboratively with PSCO to ensure the implementation of PV as a high quality energy service. PSN is not the third party mentioned in the CO PUC tariff. The third party referral service has yet to be identified. PSN and PSCO will most likely be named on the third party referral list as qualified PV system providers along with a host of other qualified local providers.

Access

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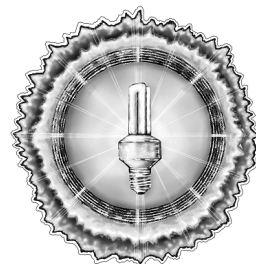
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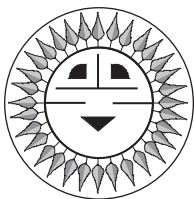
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Clarifying Confusing Cables



John Wiles

Sponsored by The Photovoltaic Systems Assistance Center
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The National Electrical Code (NEC)[®] contains numerous references to different cable and conductor types. Some types are intended for fixed, non-moving installations. Other types are designated for installations where various parts must move. Some cable types can be used in either fixed or moving installations. Each cable type is designated by a series of letters and numbers that refer to the size of the conductor and the type of insulation. This Code Corner will attempt to shed a little light on the murky subject of conductors and cables.

Conductors, Cables, or Wires?

A conductor is something that is meant to conduct or carry electricity. It is normally made of copper, but can also be made of other metals like aluminum. Today, however, copper is the most commonly used conductor in both PV and residential electrical systems. It can be bare, with no covering or electrical insulation, or insulated.

The size of the conductor is expressed as an American Wire Gauge (AWG) with designations from number 27 AWG, the smallest size mentioned in the NEC[®], to number 4/0 AWG or 0000 AWG (called "4 aught"). Conductors larger than 4/0 AWG are specified in kcmil (thousands of circular mils), a cross-sectional area designation, and range from 250 kcmil up to 2000 kcmil (with a diameter of about 1.6 inches).

Conductors may be solid copper (usually 6 AWG and smaller) or may be stranded. Stranded conductor is composed of several strands of a smaller conductor twisted together. Typical stranded conductors from 18 AWG through number 2 AWG have seven strands. Conductors from 1 AWG through 4/0 AWG have 19 strands. Conductors 250 kcmil through 500 kcmil have 37 strands. In each of these sizes, conductors are available on special order that have considerably more strands for added flexibility. For example, a 4/0 AWG conductor may have 437 strands of very small copper conductors rather than the 19 strands in the standard conductor.

Cables are usually defined as conductors covered by insulation, although in many cases, the term conductor and cable are used interchangeably. Cables may have only a single conductor, or may have multiple, individually-insulated conductors. Some multiple conductor cables have an external insulating outer covering or sheath. Others do not, and the individual conductors are just twisted together.

The term "wires" is used in the NEC[®] to refer to the general use of cables or conductors. Reference may be made to a wiring system, wire size, wire sag, and similar terms.

Grouping of Cable Types

In the NEC[®], there are two distinct groups of cables. One group represents the building-wiring types of cables. They are primarily used in fixed, non-moving installations such as buildings and are the principle types of cables used in wiring PV systems. These types of cables are identified in Table 310-13 of the NEC[®], and the proper methods of installing these cables may be found in Chapter 3 of the NEC[®].

The second grouping of cable types is the Flexible Cords and Cables found in Article 400 of the NEC[®] and described in Table 400-4. These cables are used where there is motion between two parts that are electrically wired together. Such cables are used on appliances, tools, elevators, cranes, and other industrial applications. PV trackers represent a moving installation where flexible cords could be used.

These types of cables are specifically prohibited in Section 400-8 of the NEC[®] from being used as a replacement for fixed wiring. One of the reasons for this prohibition is that flexible cords have not been tested, evaluated, or listed for fixed uses such as being placed in conduit or run through walls. Another reason is that these flexible cables are generally installed in exposed locations where damage is readily visible and the need for replacement is evident. There are numerous other prohibited uses where the code says that if a fixed,

building-wire cable can be used, the fixed cable is to be used in lieu of a flexible cable.

Insulations and Cable Markings

Cables have insulations that are made of different materials for different applications. The letters and numbers of the outer covering of the cable provide information on the cable and where it can be used. The tables in Chapter 3 and Article 300 of the NEC® generally specify under what conditions each cable type can be used. Listed below are some of the cables that can be used in PV systems starting with the building-wire types of cables.

Cables for PV module connections

Exposed, single-conductor cables are allowed for PV module connections by NEC® Section 690-31. The following are the types allowed:

USE: Underground Service Entrance • 75°C, wet insulation rating • Heat and moisture resistant • Sunlight resistant, but not marked as such.

USE-2: As above, but with a 90°C, wet insulation rating. The most commonly recommended cable for PV module wiring.

UF: Underground Feeder • 60°C, wet insulation rating • Not sunlight resistant unless marked • Hard to find and not recommended due to the low, 60°C temperature rating.

SE: Service Entrance • Temperature rating is variable and is marked on the jacket • Sunlight resistant, but not marked • Hard to find in a single conductor.

PV modules may also be connected with conductors installed in conduit (metal, plastic, flexible, rigid, etc.). Since the conduits are exposed to the elements, they are considered to be wet locations (even in the hot, dry, sunny Southwest), and wet-rated conductors with 90°C insulation should be used for PV module wiring. The following types are the cables typically used.

THWN-2: Moisture and heat-resistant thermoplastic • 90°C, wet and dry insulation rating • May also be marked THHN. A cable marked only with THHN is not suitable for use in exposed conduits.

THW-2: Moisture and heat-resistant thermoplastic • 90°C, wet and dry insulation rating • May also be marked THHW.

RHW-2: Moisture and heat-resistant thermoset (rubber) • 90°C, wet and dry insulation rating • May also be marked USE-2 and/or RHH.

XHHW-2: Moisture and heat-resistant thermoset (cross-linked synthetic polymer) • 90°C, wet and dry insulation rating.

In these and other markings on cables, the letters and numbers have meaning.

T: Thermoplastic insulation

R: Thermoset insulation (rubber or synthetic rubber)

X: Cross-linked synthetic polymer insulation

H: High temperature (usually 75°C when dry or damp)

HH: Higher temperature (usually 90°C when dry or damp)

W: Moisture resistant (usually 60°C when wet)

N: Nylon jacket

-2: High temperature and moisture resistance (90°C wet or dry)

Combinations of these letters and numbers change the definitions somewhat.

Wiring away from the PV modules must be one of the building-wire type of wiring systems. These methods are discussed in Chapter 3 of the NEC®. Single-conductor exposed cables are generally not allowed nor are unjacketed multiple-conductor cables.

If protected from mechanical damage and not exposed to high temperatures, a UF multiple-conductor jacketed cable might be used. However, since the cable is limited to 60°C by Section 339 of the NEC®, it is generally not applicable outside the structure where higher temperature ratings are required.

Inside the structure, the conductors listed above may be used inside conduit. Additionally, since the temperature requirements are less, and the conduits are no longer exposed, 75°C, damp-rated insulation versions of these conductors may also be used (THHN, THW, RHW, XHHW, or RH). Local electrical codes generally require conductors in conduit for all commercial wiring.

Non-metallic sheathed cable (Type NM) also known as Romex® is commonly used for interior residential wiring where it can be installed properly inside walls in accordance with NEC® Section 336. Note that type NM cable is specifically excluded from storage-battery room applications.

PV Trackers

Trackers contain moving parts and as such may be wired with flexible cables. However, the slow rotation rates of trackers (1300 revolutions per decade) generally allow the use of the stiffer building-wire types of cable, and are therefore recommended. Also available are building-wire types of cables with extra-fine strands for additional flexibility where required.

If flexible cables are to be used, then types identified in Article 400 of the NEC® are appropriate. The markings

shown below should always be accompanied with the letters "W-A" to indicate that the cable is suitable for outdoor use.

Flexible cords suitable for PV tracker connections on trackers are: SE, SEO, SEOO, SJ, SJE, SJEO, SJEOO, SJO, SJOO, SJT, SJTO, SJTOO, SO, and SOO. These are all hard-service or extra-hard-service flexible cords. With the "W-A" rating, they are also suitable for outdoor use. Again, each of the letters has meaning:

- S:** Hard Service Flexible Cord
- SJ:** Junior Hard Service Flexible Cord
- E:** Thermoplastic elastomer insulation
- T:** Thermoplastic insulation
- O:** Jacket is oil resistant
- OO:** Jacket and Conductors are oil resistant

Battery Cables

Battery-to-inverter cables are usually large in size. They should be installed in conduit when being used between the battery enclosure and other equipment. As mentioned above, extra-flexible building-wire cables are available that may make the installation somewhat easier. Extra-flexible types that are available include THW, RHW, and USE. Since most batteries are in sheltered areas, cables with only a damp-rated, 75°C insulation are required.

Section 690-74 of the NEC® allows the use of Article 400 flexible cables for inter-cell battery connections as well as the connections from the battery to a fixed-wiring system. Since single-conductor Article 400 cables (types SC and W-this is not welding cable) are not readily available, it is suggested that extra-flexible, building-wire types of cables be used for connections to the battery when it is deemed necessary to use flexible cables.

Welding cables and automotive battery cables are not recognized by the NEC® for use in wiring electrical power systems.

Listed Cables

All conductors (except bare) and all cables should have all size and insulation type information plus the listing mark printed on them. The listing mark will normally be the "UL", indicating that Underwriters Laboratories, Inc. has evaluated the cable for the intended use.

Summary

The choice of the proper cables for PV installations is relatively straightforward. Most cables are available locally or are stocked by PV distributors. Using the correct cable in each application will ensure a durable, safe, long-lasting PV system.

Questions or Comments?

If you have questions about the NEC® or the implementation of PV systems following the requirements of the NEC®, feel free to call, fax, email, or write me at the location below. Sandia National Laboratories sponsors my activities in this area as a support function to the PV Industry. This work was supported by the United States Department of Energy under Contract DE-AC04-94AL8500. Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy.

Access

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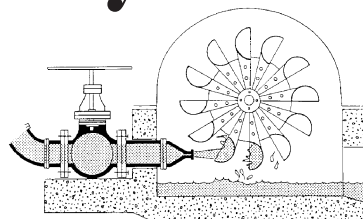
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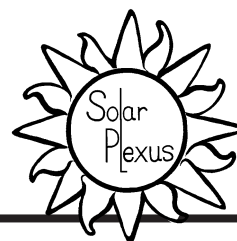
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WRENCH REALITIES



Bob-O Schultze, Don Lowebug,
Wes Edwards, and Redwood Kardon

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This month's column is written by three Wrenches with over 500 installed systems under our collective belt. Over the years, we've discovered a few realities about PV systems that can't be learned by studying theory or demonstrated under laboratory conditions. This is real world information. Why the NEC, Sandia, and Mr. Wiles continue to ignore it in favor of their own untested theories is beyond us.

Safety

Why is it that every time Mr. Wiles comes up with a scheme for doing any part of a PV installation, it adds yet another layer of complexity and cost to the project? Most engineers and theorists strive to simplify an application or technique. Sometimes, we Wrenches just have to wonder what his motives really are. A healthy respect for the power of electricity is a good thing, but I get the feeling that Mr. Wiles is basically scared of it.

It's really difficult to knock someone or something touting safety. No one wants to give the impression of being cavalier about it, especially when it comes to

electricity. So, if a little safety is a good thing, more must be better, right? Not necessarily. There are acceptable levels which make good sense for the protection of personnel and property. Beyond that lies needless extra expense and complexity in ever increasing spirals.

For example, most of us will agree that seat belts in vehicles are a good thing. They save lives. So many of us agree, in fact, that wearing seat belts is mandated in most states. It can also be statistically proven that wearing crash helmets and fire resistant clothing in addition to seat belts will save even more lives. Therefore, we should mandate them as well, right? You see the point.

Grounding

The easiest explanation of grounding I've seen is written by Redwood Kardon, author of *Code Check: A Field Guide to Building a Safe House*. Rather than try to paraphrase it and inadvertently make it more confusing than it already is, here are Mr Kardon's words:

Grounding is probably the source of the greatest confusion in the understanding of electrical power distribution. The National Electric Code does little to clear this fog of misunderstanding. It lists the purpose of grounding as:

1) "To limit voltages due to lightning, line surges, or unintentional contact with higher voltage lines and to stabilize the voltage to ground during normal operation"

These three sources of dangerous overvoltage are provided with an alternative path around the electrical system of your home or workplace by intentionally connecting the system to the earth.

In practice, this proviso of the code only minimizes damage from such occurrences. If lightning is a common occurrence in your area, additional provisions must be made to protect your property.

2) "To stabilize voltages"

This is a difficult concept. There are many sources of electricity. Every transformer can be considered a separate source. If there were not a common reference point for all these voltage sources it would be extremely difficult to know their relationships to each other. The earth, of course, is the most omnipresent conductive surface, and so it was adopted in the very beginnings of the National Electric Code as a nearly universal standard for all electric systems. (There are a few exceptions where ungrounded systems are permitted, as in direct current systems operating at 50 Volts or less between conductors).

3) "To provide a low impedance path...that will facilitate the operation of overcurrent devices."

From a day-to-day point of view this last purpose of grounding is the most important one to understand.

Most PVs get installed as 12 or 24 VDC systems. The DC charging and direct use parts of these systems are exempt from the grounding requirements of the NEC. For some inexplicable reason, the NEC requires that while the conductors of a PV system less than 50 VDC need not be electrically grounded, any metal frames, boxes, etc. in that system still do. Frankly, I don't understand the need for it.

To Ground or Not to Ground

NEC section 250-42 states that "Exposed noncurrent-carrying metal parts of fixed equipment likely to become energized shall be grounded...." The explanation in the NEC handbook states that "Exposed noncurrent-carrying metal parts of fixed equipment not likely to become energized are not required to be grounded." When we look at the typical PV module, we see a metal frame which is not connected in any way to the PV cells themselves. We see a non-metallic junction box fully insulated from the frame where the wire connections take place. Is any of this "likely" to become energized? I don't think so.

By the way, the 1996 Code states that "in a photovoltaic power source and its direct-current circuits, the voltage considered shall be the rated open circuit voltage." It also details that "for a photovoltaic power source, one conductor of a two-wire system rated over 50 Volts...shall be solidly grounded." Notice the word 'rated' in both quotes? Look on the back of your PV module. Look at the 1996 NEC. Do the math. Never mind Mr. Wiles interpretation or someone's explanation in the NEC handbook (after all, that handbook is not the Code, and I'm guessing that Wiles had his hand in it as well).

We can debate whether this grounding is really necessary to insure safety. However, the question of whether the PV equipment ground needs to be electrically bonded to any other parts of the system still remains.

Refer to the drawing in Code Corner, *HP 64*, p. 73. It shows a PV module grounded to a ground rod which is connected to a grounding bus and hence to the main ac system grounding rod. Let's assume that the PV system operates at less than 50 VDC and is some distance from the house. Let's further assume that at least the ac load center is in the residence. In fact, this is the case with nearly all PV systems. Locating a grounding rod close to the PV array makes good sense for lightning protection. Bonding that ground rod to the ac ground

rod serves no good purpose other than inviting lightning induced currents into your house! Is this smart? Is this safe? Is this logical?

Some Field Data

This input comes from Don Lowebug, a fellow Wrench for many years and a licensed electrical contractor:

I have long doubted the necessity of placing ground jumpers from module to module when they are bolted to a metal frame. As a matter of personal inquiry, for the last 5 years, I have routinely checked ground continuity without the jumper wires on each and every racked system I have installed. In no case was there ever lack of ground continuity for even one module in all those years. I have always found the resistance to be under one ohm. On occasions, I've had the opportunity to return and check the grounding after some number of years. Again, ground continuity has been 100%. I would hope others with field experience might pass on their findings. If, as I suspect, we find ground continuity on metal racks is achieved without the jumper wires, I suggest we drop this nonsense. I suspect that some "expert" made this up. Now the gospel is blindly passed on year after year, adding cost but no value to PV systems.

Another grounding issue that gets me is the oversize ground requirement if current carrying conductors are oversized. Because the code does make explicit reference here, I'm not ready to take it on. But it does seem like nonsense to me. Especially with array source circuits which are absolutely current limited. Logically, ground wire should be sized according to the maximum fault current possible. We did away with oversize grounds on the inverters. Why must it persist elsewhere?

This long term module to rack continuity has been my experience as well, but it's not universal. The differences seem to be in the initial mounting practices. If a stainless steel lockwasher or star washer (which is even better) is used to get a good "bite" on the module frame or rack from the beginning, little resistance is measured even after many years. I'm thinking of using at least one star washer between each PV module frame and the rack on all my installations. It's cheap, easy, and can't hurt. I believe it will meet both the spirit and letter of the NEC without using all that unnecessary and unsightly ground wire.

Yet Another Wrench Chimes In

This is from Wes Edwards, a long-time RE electrician:

Like Don, I no longer install jumpers from panel to panel. I have checked resistance between module

frames and the mounting structures and have found no resistance to speak of, even on a seven-year-old array. It makes no sense to add jumpers if they serve no purpose. In fact, the copper jumpers corrode because copper and aluminum are dissimilar metals. Any ham radio operator knows that ground wires will act like an antenna for lightning. If you connect your array back to the house ground, you are in effect adding a large antenna to the solar array. As Bob-O mentioned, the electrical connections and the boxes that contain them are completely isolated from the frames, so the only reason to ground is for lightning protection or static electricity discharge. When I set up a system, I use a separate ground rod connected to the steel structures, not connected to any other grounding system.

Most explanations of grounding the ac neutral and the DC negative are confusing. In fact, an experienced system designer from AEE was totally confused by John Wiles' article in the last *HP*. It had to do with grounding the array feed at the disconnect. First of all, it makes perfect sense to ground these conductors at one, and *only* one place. If you don't, current will flow through your ground wires. This can cause big problems. I have seen Trace inverters go up in smoke because the neutral was grounded in two places. Trace claims this is not a problem, but I have seen two inverters smoke at the same residence. I checked the system and found that it was neutral bonded in two places. I corrected that, reinstalled the inverter, and it has been working perfectly for two years now.

On grounding the battery negative, the bottom line is, "Why do we ground it at all?" I would like to hear just one good reason. I do it—but why?

Conclusions

Again, we are talking about 12 and 24 VDC systems. In higher voltage systems where an electrical shock hazard can be demonstrated rather than mostly theoretical, I have to agree that protection is the best policy. In that case, protecting against the potential shock hazard outweighs the possibility of lightning-induced currents trashing your inverter or setting your house on fire. It's a question of risk management and acceptable levels of safety. I wear seat belts and advise you to do so as well. Mr. Wiles, on the other hand, advocates the equivalent of mandating the crash helmet and fire-resistant jump suit.

Calling All Wrenches

A "Wrench" is someone who is actually involved in the installation of RE systems. In other words, them what's doin' as opposed to them what's talkin'. IPP members,

folks who have installed their own systems, and many others are mostly Wrenches. It boils down to this: the main depository of the information and data needed to realistically and safely install renewable energy systems is in the memory banks and records of Wrenches who have been doing the actual work for years. Got a gripe or a better idea on how to install a system safely and more simply? Write us about it! A few of us can't do much. If we're to successfully counteract some of the more onerous and unnecessary provisions of the NEC as it applies to RE systems, we'll have to do it together.

Access

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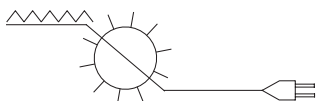
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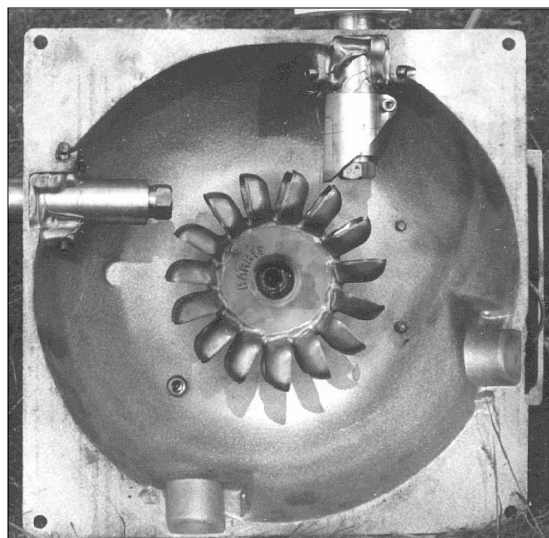
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Kathleen Jarschke-Schultze

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I have come to view the Nineties as the Decade of No Damn Time. Is there a way of getting projects done (as in completed) and staying sane at the same time? When people visit us to see our home and system, they see what we have done. When Bob-O and I look around, we only see what needs to be done.

Lists

I became enamored of lists when we lived on the Salmon River, five hours from town. We would make a list, duplicate it, each carrying one. Every six weeks we would make a run to the town, spending the night in a motel in order to complete our lists. Now, I keep a small tablet, with attached pencil, on the bulletin board in the kitchen. Who ever will be in town next takes the list. Whatever didn't get done is brought home and transferred to the new list.

What about lists for projects? Some very good friends of ours are building their home. I've heard it said that when you build your own home, you're never done. That's also true of a retrofit home. Anyway, these friends have a list of projects taped to the refrigerator door. They list the project in one column and the cost of the project across from it. These are house projects, automotive projects, yard projects and even pleasure projects (like a week in Yosemite).

As the time and money coincide for each project, it is completed and crossed off the list. This seems like a fairly efficient method of organization. However, at the top of the list is the heading, "Things to do in 1995, 96, 97, 98". Still, the focusing of intent and cost is impressive.

My friend, Anita, says that she used to erase the completed projects off of her refrigerator list. The problem with doing it that way was that you didn't have the satisfaction of seeing the completed projects crossed out. All that you saw was what was still waiting for you. It's a good idea to take and keep photographs of your projects as the phases move along. It's another necessary affirmation of forward progress.

Frustration Levels

Another facet of project completion is the frustration level. It is commonly known among homeowners that in order to get to the prime project, you must first complete three other projects. One of those multilayer projects waiting for me will begin with covering the garden paths with weed barrier paper. Then I need to spread the pile of sawdust on top of that. Once I've done this, I can move the pile of rocks (which will someday be a small patio in the garden) to where the sawdust was. When I reach this point, I'll finally be able to build a round raised bed in the place where the rocks were before.

My seventh grade Homemaking Teacher told us, "Never leave a room empty handed. Something in the room you are in needs to go to the room you are going to." She was right. She also said, "Do as I say, not as I do". I liked her a lot.

Old Books, New Books

A reader e-mailed me asking for a source of information on smoking meat. I referred him to the older edition of *Stocking Up*, a homesteading classic. I also have the new edition, but in this newer version they omitted all references to the smoking of meats because of the risk of coming in contact with carcinogens in the process.

I recently tried to find an ice cream recipe for a Japanese potluck that our neighborhood is planning. I wanted one that could be modified to taste like green tea. The new edition of *Joy of Cooking* had absolutely nothing on homemade ice cream. My old and battered early edition had three pages of information and recipes.

No meat smoking instructions because of carcinogens, no ice cream recipes because of fat content. Frankly, I want to be able to decide if I'll risk the health detriments of smoked salmon and green tea ice cream. Get the new book, but save the old. I do.

Tornado Watch, Fireflies and Friends

We just came back from the Midwest Renewable Energy Fair in Amherst, WI. It's their ninth year, and it was great. For the Home Power Crew, it's a yearly pilgrimage to see friends and get our enthusiasm recharged. The weather was in a state of change the whole time we were there. For a couple of hours, Portage County was on tornado watch. Everyone was quick to assure me it was 'watch' not 'warning'. I'm such a chicken.

Every time we go to the Midwest, I am fascinated by the fireflies. They are so cool. They turn a walk after dusk into a magical experience. I complained to someone that we had no fireflies at home. They pointed out that if

we had the Midwest humidity, and thus the tornadoes, we could have fireflies too. I guess I'll just visit every year.

The MREA Crew is so great. They now have a permanent renewable energy display home at the fairgrounds. It's a work of art and shows their dedication. They will be holding workshops there throughout the year. Talk about getting things done—these people sure know how! It takes so much hard work to pull it off. The whole MREA Crew and Volunteers have our thanks and admiration for a job extremely well done. Next year will be the tenth anniversary of MREF. Be there, or miss out!

Solar Correction

In my last column I stated, "(focusing) is done by standing behind your cooker and pointing it so that there is a slight shadow on the LEFT hand side of the cooking area. This way, the sun will always be coming into focus, keeping the food at maximum temperature, rather than unfocusing and lowering the temperature."

Two of my editors, (both male, both non-solar cooks) read my copy and performed the classic lateral arabesque or the great leap sideways. They thought that I meant "RIGHT". I did not. The paragraph above is correct.

I just got a parabolic solar cooker from Blackhawk Solar. It is called a Sundyne and is made in the Philippines. It took me two hours to assemble, but I wasn't hurrying. So far, my advice is to assemble it in the shade so that you won't be hit by the glare. In the coming weeks, I will be trying out this cooker. Since they're from the Philippines, there is a limited number of the Sundyne cookers available.

Access

Kathleen Jarschke-Schultze is trying to finish that darn hammock weaving project she started two years ago at her home in Northernmost California, c/o Home Power Magazine, PO Box 520, Ashland, OR 97520
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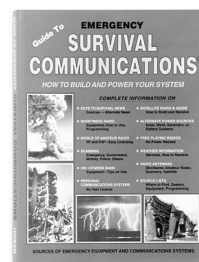


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October 1-3, 1998: 15th International Electric Vehicle Symposium and Electric Vehicle Expo, Brussels. Contact: EPE Assoc., c/o SRBE-KBVE, c/o VUB, Pleinlaan 2, B-1050 Brussels, Belgium Phone: 32-2-629-28-19 • Fax: 32-2-629-36-20 bsneiders@vub.ac.be • www.avere.org/evs15

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Nov: SENESE X, the tenth annual version of the Congress of Sustainable Energies, Punta Arenas, Chile. Short speeches showing the progress of research work from the academic sector of Chile & many Latin American countries, state of the art renewables/technologies, discussions on promoting & reinforcing their application, & participation from NREL researchers. Paul Gipe is invited. Contact Arturo Kunstmann F. Director CERE/UMAG, Center for Energy Studies, University of Magellan, Casilla 113-D, Punta Arenas, Chile • (56-61) 207185 Fax (56-61) 207184 • Email: cere@ona.fi.umag.cl http://members.xoom.com/senese/

CHINA

Oct. 20-22, 1998: International Conference & Exhibition on Energy & Energy Conservation, Shanghai Mart, Shanghai. Contact: ICEEC, Rm 1322 Bldg. 3, 1486 Nanjing Rd. (W), Shanghai 200040, P.R. China • Fax: 86-21-62049481 wjyao@online.sh.cn.

Oct 14-16, 1998, Renewable Energy & Energy Efficiency Asia-Pacific '98 (REAP'98) Conference and Exhibition, Shanghai, China. Contact: Alternative Development Asia Limited, 1406 Leader Commercial Building, 54-56 Hillwood Road, TST, Kowloon, Hong Kong • +852-2574-9133 Fax: +852-2574-1997 • Email: office@adal.com Web: www.adal.com

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4th annual contest: High School students: design a PV-powered device. Originality, presentation, & understanding judged. 1st prize: \$500. Prizes for other winners, teachers, & schools sponsoring entries. Sponsored by PRSEA Chap of ASES. Contact: solstice.crest.org/renewables/prsea/ National Summary Reports on State Financial and Regulatory Incentives for RE. Most current info on state and federal tax, grant & loan programs that target RE. To order these two reports, contact: North Carolina Solar Center, Box 7401 NCSU, Raleigh, NC 27695 • 919-515-3480 Fax: 919-515-5778 • Online Database of State Incentives for RE: www.ncsc.ncsu.edu/dsire.htm Sandia's new WWW address is www.sandia.gov/pv New material, organized better. Includes "Stand-Alone Photovoltaic Systems: A Handbook of Recommended Design Practices", "Working Safely with PV," & balance-of-system technical briefs, providing information on battery & inverter testing. American Hydrogen Association nat'l headquarters: 1739 W 7th Ave, Mesa, AZ 85202-1906 602-827-7915 • Fax 602-967-6601 Email: aha@getnet.com • "Prosperity Without Pollution" Web: www.clean-air.org

Sept 1 - Oct 9, '98: On-Line PV Design course: Learn how to design a complete solar electric PV-powered system without leaving your home. An internet based, on-line course of instruction with text, software, CD-ROM reference materials, and Internet resource links. Tuition: \$350, Course material: \$150. Contact: Solar Energy International (SEI), PO Box 715, Carbondale, CO 81623 970-963-8855 • Fax: 970-963-8866 Email: sei@solarenergy.org Web: www.solarenergy.org/classroom

Solar Energy & Systems is a college credit course, taught on the Internet using the latest technology. Covers fundamentals of RE for the homeowner or small village. Features weekly assignments reviewing various texts, videos, WWW pages, weekly chat room, & email questions and answers. Offered by Mojave Community College. Tuition is \$100 plus \$10 registration. 800-678-3992 or email Elizabeth Cawley: lizcaw@et.mohave.cc.az.us Prof Collins: chacol@hal.mccnic.mohave.az.us American Wind Energy Association World Wide Web: www.igc.apc.org/awea. Obtain information about the US wind energy industry, AWEA membership, small turbine use, & much more.

DOE Online Energy Info Resources: Info on energy efficiency and RE technologies. Energy Efficiency & Renewable Energy Clearinghouse (EREC) BBS Online Service offers users free access to text files, share/freeware programs & utilities, & a free publication ordering system. Accessible via the Web: erecbs.nciinc.com • Modem: 800-273-2955. Energy Efficiency and Renewable Energy Network (EREN), accessible on the Web: www.eren.doe.gov provides links to hundreds of gov't and private internet sites & offers an "Ask an Energy Expert" online form allowing users to email questions directly to specialists at EREC. • 800-363-3732

Energy Efficiency and Renewable Energy Clearinghouse (EREC) offers free info: 1998 Fuel Economy Guide (SD404), Insulation Basics (FS142), New Earth-Sheltered Houses (FS120), PV: Basic Design Principles and Components (FS231), Cooling Your Home Naturally (FS186), Automatic & Programmable Thermostats (FS215), & Small Wind Energy Systems for the Homeowner (FS135), reviewing site determination, system requirements, & costs of residential wind turbines. Contact: EREC, PO Box 3048, Merrifield, VA 22116 800-363-3732 • TDD: 800-273-2957 Email: energyinfo@delphi.com Modem: 800-273-2955 • Web: www.eren.doe.gov

The Federal Trade Commission is offering free pamphlets: Buying An Energy-Smart Appliance, the EnergyGuide to Major Home Appliances, & the EnergyGuide to Home Heating and Cooling. EnergyGuide, Federal Trade Commission, Room 130, 6th St and Pennsylvania Ave NW, Washington, DC 20580 • 202-326-2222 • TTY: 202-9326-2502 Full text of 160+ consumer and business publications are available • Web: www.ftc.gov Surface Solar Energy data set, derived from satellite observations, & produced by the Atmospheric Sciences Division of NASA Langley Research Center, now available. Contains site specific insolation values w/monthly fluctuations, 3 hourly cloud fraction, & more. Global scaleText files, color plots & contour plots. Web: eosweb.larc.nasa.gov/DATDOCS/Surface_Solar_Energy.html

The Interstate Renewable Energy Council (IREC), in cooperation with the SEIA and Sandia National Lab has a handbook to guide state and local government procurement officials and other users in the specification and purchase of RE technologies. Biomass, PVs, solar domestic water

and pool heating, & small wind systems.

Technology specs re equipment, photographs and vendor contact info. Simple methods for estimating the pollution benefits of RE systems. Send \$US15 ppd to Interstate RE Council Distribution Center, c/o ASES, 2400 Central Ave Ste G-1, Boulder, CO 80301 (make checks to ASES)

Oct 17, '98: annual National Tour of Solar Homes. Solar energy is clean, quiet, and reliable. See for yourself. All around the US, solar homeowners will open their doors to visitors for a first-hand look at practical uses of RE. These are real places, for real people, featuring solar heating, PVs, and energy conservation. To find a tour near you, contact: American Solar Energy Society at 303-443-3130 www.ases.org/solar

Green Power web site, www.green-power.com, contains an on-line discussion group providing a forum for consumers, policymakers & green providers to discuss green power issues including electricity deregulation, the arrival of "green" electricity choices, technology, marketing, standards, environmental claims & varying national and state policies. Links to existing on-line info, articles & news. Launched by Global Environmental Options (GEO) & the Center for Renewable Energy and Sustainable Technology (CREST). GEOs other web sites include www.greendesign.net & www.greening.org • For more sustainable energy info, CREST web site: www.crest.org

Non-profit Tesla Engine Builders Association (TEBA) provides info & networking for building efficient Tesla disk turbines. The 18" diameter, single stage steam version, operating at 9,000 rpm has been documented to consume 38 lbs of saturated steam per hp/hr @ 125 lbs inlet pressure & free exhaust. Send an SASE to TEBA, 5464 N Port Washington Rd Suite 293, Milwaukee, WI 53217-4925 • Email: teba@execpc.com • visit the TEBA website at • <http://www.execpc.com/~teba>

ALABAMA

The Self-Reliance Institute of Northeast Alabama is seeking others in the southeast interested in RE, earth sheltered construction, & other self-reliant topics. Contact: SINA, Route 2 Box 185A1, Centre, AL 35960 • Email: cevans@peop.tdsnet.com

ARIZONA

Tax credit for installation of all types of solar energy systems in Arizona. A solar technician certified by the AZ Department of Commerce must be on each job site. Contact: ARI SEIA • 602-258-3422

Sept 19-20, '98: Southwest Energy Fair, Flagstaff, Arizona. Technical, general public, & children's workshops. Project, debate, & essay contests for students. Electric car race & EPCOT center solar exhibit. Commercial booths, on-site camping, & numerous free recreational opportunities for vendors will be available. Looking for individuals & companies to give demonstrations, hold workshops, & contribute ideas. Contact: Greater Flagstaff Economic Council • 800-595-7698 Email: gfec@primnet.com

Dec 3-4, '98: North American Electric Vehicle & Infrastructure Conference and Exposition, Phoenix, AZ. Contact: EVAA, 601 California St Ste 502, San Francisco, CA 94108 • <http://www.evaa.org> ev@evaa.org • 415-249-2690 • Fax 415-249-2699

Sept 16, '98: Meeting: Rio Salado Chapter, Arizona Solar Energy Association. For time and place, contact Mr. Art Rivera, Chairperson • 602-256-9229 Fax: 602-256-6119 • Email: rms@digitalt.com

CALIFORNIA

Campus Center for Appropriate Technology, Humboldt State University, Arcata, CA has ongoing workshops and presentations on a variety of alternative, renewable, and sustainable living

subjects. Contact: CCAT, HSU, Arcata, CA 95521 707-826-3551 • Email: ccat@axe.humboldt.edu Web: www.humboldt.edu/~ccat

Aug 21-23, '98: Home Education Conference, HomeSchool Assoc. of CA, Radison Hotel, Sacramento, CA. Contact: PO Box 2442, Atascadero, CA 93423 888-HSC-4440 Email: conference@hsc.org • Web: www.HSC.org

Siemens Solar Industries offers two levels of PV training: Basic PV Technology Self-Study Course (continuously available prerequisite), & Comprehensive Photovoltaic System Design Seminar (call for dates). Instructor: Mark Mrohs, Manager of Training for Siemens Solar. Self Study program includes: 500-page Training Manual, 9 hours of video lessons, applications, w/exercises & examples. (\$500 plus shipping & tax). System Design Seminar: 5-day intensive lecture, hands-on assembly, labs, & team system design problem solving. (\$1000). Contact: Siemens Solar Training Dept, 805-388-6568 • Email: cvernon@solarpv.com Fax: 805-388-6395 • Web: www.solarpv.com

Rising Sun Energy Center presents ongoing Solar Energy Classes incl electricity, water heating, cooking, & kids day. For schedule and info: PO Box 2874, Santa Cruz, CA 95063 • 408-423-8749 Email: sunrise@cruzio.com Web: www.cruzio.com/~solar

Oct 23, 24, & 25: Alameda International Electric Vehicle Exposition, at the former Naval Air Station, Alameda, CA. Electric, educational, exciting & entertaining family fun. Displays of experimental EVs, production & near-production EVs, EV equipment & transportation. EV Races; Ride & Drive opportunities. Demonstrations of electricity & EV transportation. Looking for sponsors & exhibitors. Organizers: City of Alameda Bureau of Electricity, CALSTART, the Alameda Chamber of Commerce and Winnett Exposition Services, Inc. Contact: Cherry Hozian, 20, Winnett Exposition, Svc. Inc., 1090 Adams Street Ste. D, Benicia, CA. 94510 • 707-747-6399 • Fax: 707-747-6437 cherryh@wes-scs.com • www.EVExpo.com

Nov 4-5: Power Matters '98, conference & exposition on California's deregulated energy market, Oakland, CA. Contact: Terry Bursztynsky 510-464-7964 • Email: terryb@abag.ca.gov Web: <http://www.abag.ca.gov/services/power/pm> conference/powermatters.html

COLORADO

Solar Energy International (SEI), a non-profit organization dedicated to the practical use of RE. offers hands-on workshops on the practical use of solar, wind, & water power. The Renewable Energy Education Program features one & two week sessions: PV Design & Installation, Advanced PV, Wind Power, Micro-hydro, Solar Cooking, Environmental Building Technologies, Solar Home Design, & Straw Bale Construction. Experienced instructors & industry representatives. For owner-builders, industry technicians, business owners, career seekers, & international development workers. Workshops may be taken individually or as a comprehensive program. \$500/week. SEI, PO Box 715, Carbondale, CO 81623 • 970-963-8855 Fax: 970-963-8866 • Email: sei@solarenergy.org Web: www.solarenergy.org

National Wind Technology Center is operated by the NREL, near Golden, CO, assisting wind turbine designers & manufacturers with development & fine-tuning. Computer modeling & test pads. Call in advance • 303-384-6900 • Fax: 303-384-6901

Aug 1-2, '98: SEI is offering a special workshop: How to Establish and Operate a Successful Solar Business, for those serious about being RE professionals. Career choices, RE industry

perspective, marketing strategies, product sales & services, optimizing computer systems, legal & tax issues covered. Taught by Richard and Karen Perez, of Home Power Magazine. Both days: \$200. Advance registration required. Contact: SEI, PO Box 715, Carbondale, CO 81623 • 970-963-8855 Fax: 970-963-8866 • Email: sei@solarenergy.org Web: www.solarenergy.org

Oct 11-14, '98: The 4th NREL Thermophotovoltaic Generation of Electricity Conference, Adams Mark Hotel, Denver, Colorado. Contact: Heather Bulmer, Conference Coordinator, 303-275-4317 Fax: 303-275-4320 • Conf. Web: • www.tpv.org

Sept 8-11, '98: National Center for Photovoltaics (NCPV) Review Meeting, Adam's Mark Hotel, Denver, Colorado. Recent developments in PV from the lab to the marketplace. Highlights from the PV programs at the National Renewable Energy Laboratory & Sandia National Laboratory, R&D, manufacturing technology advances, new int'l markets, & PV applications in federal & private sectors. Contact: Heather Bulmer, Conference Coordinator, 303-275-4317 • Fax: 303-275-4320 Email: heather_bulmer@nrel.gov • Conference Website: http://www.nrel.gov/ncpv_prm

Sept 4-7, '98: 10th Annual Crestone Energy Fair, Labor Day weekend: Workshops! Music! Dealers! Demonstrations! Solar Stage! Vendors! Camping! Food! Passive & active solar thermal systems, PV & wind energy! Alternative technologies! Visit strawbale constructions, earthships, greenhouses & off-grid homes! High in the Sangre de Cristos! Box 363, Crestone, CO 81131 • 719-256-4838

FLORIDA

Aug 20-21, '98: The Changing World Of Industrial & Recreation Electric Vehicles. Non-road vehicles & technologies. Hilton, Walt Disney World Village, Orlando, FL. Contact: EPRI, 3412 Hillview, Ave, PO Box 10412, Palo Alto, CA 94303, • 415-855-2000 Email: 222.epri.com

IOWA

Iowa Renewable Energy Association board meetings: 2nd Saturday every month at 9:00 am, Cooper's Mill Restaurant (Village Inn Motel) in Cedar Rapids. Everyone is welcome. Call for schedule change. Contact: I-Renew, PO Box 2132, Iowa City, IA 52244 • 319-338-3200 Fax: 319-351-2338 • Email: irenw@igc.apc.org

The Iowa Renewable Energy Association (IREA) is sponsoring workshops this spring on Strawbale houses, Domestic hot water installations, & DC PV systems at Prairiewoods Nature Center near Cedar Rapids, Iowa starting in June. Contact IRENEW or Tom Snyder, 611 Second St. SE, Dyersville, IA, 52040, tsnyder@mwci.net • or: Prairiewoods, 120 E Boyson Road, Hiawatha, IA 52233 • 319-395-6700 Sept 19-20, '98: Iowa Renewable Energy Expo & Alternate Fuel Showcase, Iowa city, IA. Workshops: wind energy, PVs, active solar heating, alternate building design & materials, Electrathon & demos, teachers & kids workshops, & more. Demos: wind generators, PV systems and concentrators, active solar systems, Stirling engines, EVs, solar cars, alternate fuel for cars & boats, alternate building materials, Jr Solar Sprint Ray-ses. Speakers, food, booths, fun! For info or to join IREA: 319-338-3200 PO Box 2132, Iowa City, IA 52244-2132 Email: irenw@igc.apc.org

KENTUCKY

Appalachia-Science in the Public Interest has ongoing projects and demonstrations in gardening, solar, sustainable forestry, & more. Contact: ASPI, 50 Lair St., Mt. Vernon, KY 40456 • 606-256-0077 Email: aspi@kih.net • Web: www.kih.net/aspi

NORTH CAROLINA

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Internships: Applied Permaculture Intern Program (Aug 1-Oct 30), Permaculture Fundamentals for Women (Aug 13-21), Permaculture Fundamentals (Sept 18-26), Straw Bale Construction (July 3-5), Village Design Permaculture Practicum (Sept 28-Oct 6). Contact: Culture's Edge, 1025 Camp Elliot Rd, Black Mountain, NC 28711 • 828-298-2399 culturededge@earthaven.org

MASSACHUSETTS

Greenfield Energy Park needs your help preserving Greenfield's historic past, using today's energy & ideas, creating a healthy sustainable future. Contact: Greenfield Energy Park, NESEA, 50 Miles St, Greenfield, MA 01301 • 413-774-6051 Fax: 413-774-6053

MICHIGAN

Tillers International lists classes in draft animal power, small scale farming, blacksmithing & woodworking. For a class catalog contact: Tillers Int'l, 5239 S. 24th St., Kalamazoo, MI 49002 616-344-3233 • Fax: 616-344-3238 TillersInt@aol.com • Web: www.wmich.edu/tillers
Aug 11-16, '98: Cob Workshop Intensive as part of the Michigan Women's Festival. Contact: PO Box 22 Walhalla, MI 49458 • 616-757-4766

MONTANA

Sage Mountain Center: Lifeskills Workshops, 1998. One day, comprehensive classes: Inexpensive earth-friendly home building, straw bale construction, making log furniture, cordwood construction, natural & non-toxic interiors, & more. \$45 includes lunch & literature. Contact: SMC, 79 Sage Mountain Trail, Whitehall, MT • 406-494-9875

OREGON

APROVECHO RESEARCH CENTER is a non-profit educational institute on forty acres nestled in the forest of Oregon. Internship programs March 1, June 1, and September 1. Also, a six week winter internship in Baja, Mexico which focuses on studying and researching appropriate technology applications, learning Spanish, teaching in a grade school, & working in fruit orchards & gardens. Contact: Internship Coordinator, Aprovecho Research Center, 80574 Hazelton Rd., Cottage Grove, OR 97424 • 541-942-8198

Lane Community College Energy Management Program: PV Design Course, Spring Term, 1998. Includes PV electricity basics, modules, batteries, controllers, inverters, lighting, appliances, installation guidelines, a tour of local PV installations, & creating a residential design project. PV guest speakers. Contact: Roger Ebbage, CEM, Coordinator of the Energy Management Program at LCC, 541-747-4501 ext 2451 or 800-769-9687 eggaber@lanecc.edu • <http://lanecc.edu:180/webpages/lcc/science/home.htm>

Sat, Sept 19, '98: Solar & Renewables: Coming of Age, Portland State University's School of Business Learn from local experts how to save money on your energy bills & use clean energy resources. To pre-register, Contact: Solar Energy Association of Oregon, 205 SE Grand Suite 202, Portland, Oregon 97214 • (503) 231-5662. • \$30/members, \$40/non-members, \$15/students. Pre-registration includes lunch. At the door, add \$5 (not incl lunch).

TEXAS

SEASUN, El Paso Solar Energy Association
Web: www.epsea.org

VERMONT

Free PV Workshops for beginners & experienced off-gridders. 9-3 pm, 1st Sat, most months. Topics determined by participant interest: site selection, system monitoring & maintenance, PV modules, batteries, charge controllers, inverters, lighting (ac & DC), system components, water, snow, ponds, living in cold climates, living with our woods, wood

heat, & root cellars. Visit beautiful Vermont. Meet people living with RE or considering it. Free! Bring your own lunch & coffee. Contact: David Palumbo, Independent Power and Light, RR1 Box 3054, Hyde Park, VT 05655 • Voice/Fax: 802-888-7194
Email: indeppower@aol.com

WASHINGTON

GreenFire Institute: Workshops and Info on straw bale construction. Contact: GreenFire, 1509 Queen Anne Ave #606, Seattle, WA 98109 • 206-284-7470 Fax: 206-284-2816 • Web: www.balewolf.com
Email: wilbur@balewolf.com

WE-Design: 1998 Sustainable Living Workshops, Seattle, WA. Sustainable Living Apprenticeship, July 13-Aug 9, Orcas Island (\$1500). Permaculture & Natural Building Design Course, Dates TBA, Oakville, (\$550). Contact: WE-Design, PO Box 45472, Seattle, WA 98145 • 206-323-6567

SEI Workshops in the Pacific Northwest: Classroom, lab sessions, tours & hands-on field installations. RE for the Northwest: Producing Your Own Electrical Power, Fri, Oct 16, 7 PM, Guemes Island Community Center w/free presentation: Solar, Wind, & Water Power. All day Sat & Sun sessions: practical cost-effective strategies for home power systems (\$200). PV Design & Installation: Oct 19-24. Learn how to use PV technology for "off-grid", self reliant power. Includes tours of working systems, hands-on lab & field installations. Intensive six day workshop (\$500). To register, contact: Solar Energy International, PO Box 715, Carbondale, CO 81623 • 970-963-8855 Fax: 970-963-8866 • Email: sei@solarenergy.org
For housing and logistical info, contact: Ian Woofenden, Local Coordinator • 360-293-7448
E-mail • ian@pacificrim.net

WASHINGTON, DC

Oct 28-31, '98: Excellence in Building Conference & Expo, Sheraton Washington Hotel. Building science, construction practices, marketing, utility, & gov't. programs. Contact: EEBA, 2950 Metro Dr. #108, Minneapolis, MN 55425 • 612-851-9940 Fax: 612-851-9507 • Web: www.eeba.org

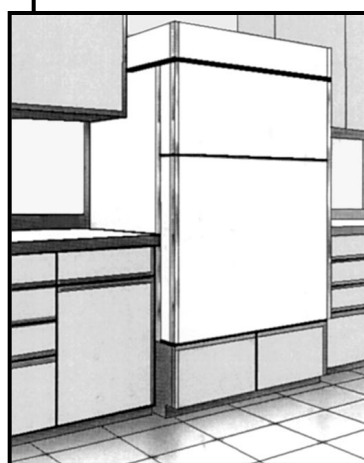
Utility PV Experience, Conference & Exhibition, sharing experience of energy service providers engaged in introducing solar electricity to customers. Contact: Erin O'Donnell, Utility Photovoltaic Group, 1800 M Street, NW, Suite 300, Washington, DC 20036 • 202-857-0898 Fax: 202-223-5537 • Email: eodonnell@ttcorp.com

WISCONSIN

Midwest Renewable Energy Association (MREA) Workshops. See our ad in this issue. Call for cost, locations, instructors & further workshop descriptions. MREA Membership & participation: all are welcome. Significant others may attend for 1/2 price. Contact: MREA, PO Box 249, Amherst, WI 54406 • 715-824-5166 • Fax: 715-824-5399

Bioenergy '98, 8th Biennial Conference, Oct. 4-8, 1998, Madison, WI. Contact: Great Lakes REgional Biomass Energy Program, 35 East Wacker Dr. #1850, Chicago, IL 60601 • 312-407-0177 • Fax: 312-407-0038 • Web: www.cglg.org/bioenergy98

Sept 14-18, '98: University of Wisconsin-Madison: Fundamentals of Energy Auditing. Learn how building energy systems operate, & how to measure performance, conduct energy audits properly & establish an energy audit program. Contact: Katie Peterson, Dept of Engineering Professional Devel., U of Wisconsin-Madison, 432 N Lake St, Madison, WI 53706 • 800-462-0876 • Fax 608-263-3160 Email: custserv@epd.engr.wisc.edu
web: <http://epdwww.engr.wisc.edu/>



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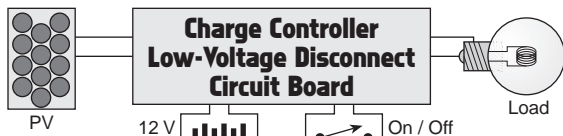
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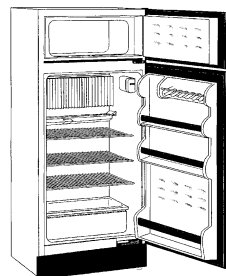
More Zero Point Field

The previous conception I had of the Zero Point Field (ZPF) was of a granular medium. This consisted of tiny discrete grains of both positive and negative charge. Since then, I have had some new ideas about the nature of the ZPF.

My first new thoughts were that the ZPF could be conceived as a flexible, continuous plastic-like medium. It would be defined by a dual-valued scalar energy density relation. Every point in space would be considered to have two solutions in this theory. By mathematically manipulating this two-valued relation, the perceived physical universe could be explained. It seemed to work OK, but was a bit abstract and hard to visualize.

Lately, I have been considering an amalgam of the two preceding theories. The basic ZPF would be a continuous fluid-like medium consisting of a charge potential field. Each point in this field would have a varying positive, negative or neutral charge density, with the net charge of the entire field being zero. This basic ZPF would produce a scalar energy field, co-existing with the original ZPF. Through quantum self-organization, charge bubbles could be formed within the ZPF fluid. The mass energy of these bubbles would be supplied by the scalar energy field. It was suggested to me that the process of charge bubble creation may be controlled by the formation of minimal surfaces with vortex topology.

I have already gone through many models trying to get a handle on the basic nature of space, so these will probably not be my last thoughts on the subject. Hopefully soon, someone will come up with a theory that is coherent enough to allow us to extract energy from these basic fields.



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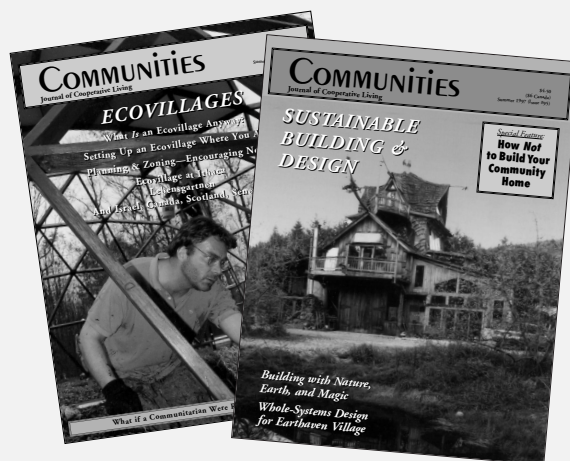
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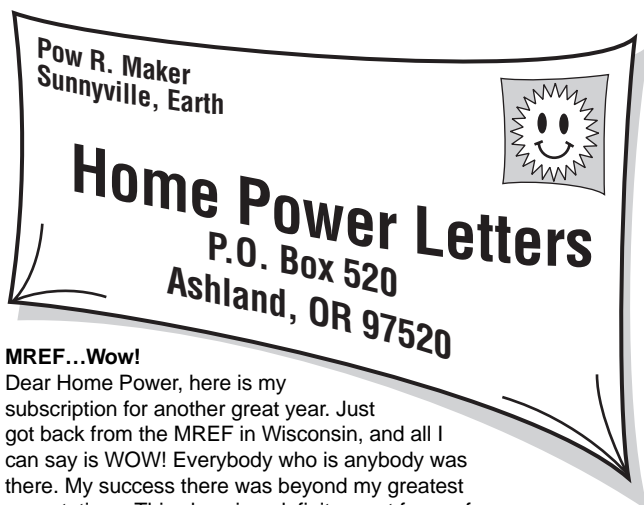


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MREF...Wow!

Dear Home Power, here is my subscription for another great year. Just got back from the MREF in Wisconsin, and all I can say is WOW! Everybody who is anybody was there. My success there was beyond my greatest expectations. This show is a definite must for me from now on.

Those folks at MREA definitely have their act together. Though I am (or was) the world's rankest cynic/conservative/realist/capitalist pig, I was enlightened by this renewable energy crowd. I was charmed to say the least by all the "hippie" men and their honesty and friendliness, and I sure do love the way the "hippie" girls dress on a hot summer's day! The biggest surprise of all was to meet the Home Power Crew.

Instead of God himself, Richard Perez looks more like Jerry Garcia than anything. Mr. Root is anything but 10 feet tall, and the nice lady who answers your 800# was more of a Dorothy than the Girl Friday I thought she would be like. Ya'll are genuine human bein's.

From a business viewpoint, this show pays for itself 10 times over. From a consumer's viewpoint, the savings and selection displayed outweigh all costs of getting there. If nothing else, the beer and music made it all worthwhile. The only question now is...what other shows are you going to be at? Keep up the great work and listening to those solar-powered Grateful Dead tapes. Thanx, Skip Goebel, Sensible Steam, 152 Von Goebels Lane, Branson, MO 65616 • 417-336-2869 • 146942@msn.com • www.geocities.com/researchtriangle/6362

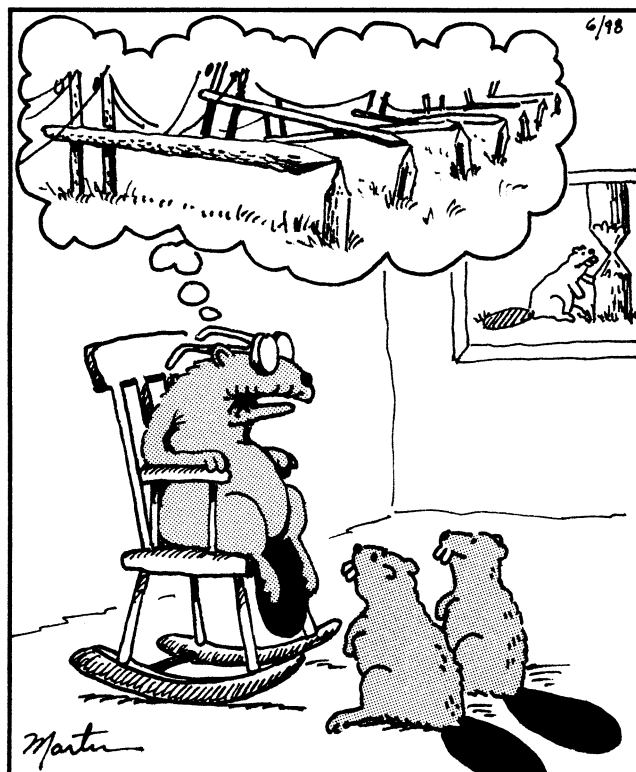
Hello Skip, it was good to meet you too. After nine continuous years, MREF has grown into the best energy event on this planet. MREF now has so many workshops, exhibitors, and attendees that is impossible to see and do everything. In addition to viewing (and sometimes buying at special fair prices) the latest RE gear, thousands of RE users meet with each other, attend workshops, and have a great time. Karen's birthday and our anniversary both fall during the Summer Solstice. We've spent the last nine anniversaries with our family at MREF. You won't find a finer group of humans on this planet. See you there again next year! Richard Perez

Stuff It

We have Pacific Light & Power at the corner of our lot in Cave Junction, Oregon. However, the estimator from PL&P was such a *Total Idiot* that we are going to make our own electricity, and they can get stuffed. The man just permanently irritated me—forever! We are in the deep woods & will have to go up 40 or 50 ft for sunshine. An article in your magazine on tower construction would be most useful. Bob Schaafsma, Napa, California

Hello Bob. While we've run many articles on towers for wind gennys, I don't think we've ever run one on towers for PV modules. Any tower which would support a wind genny should also do the job for a moderate-sized PV array.

Try this: contact Bill Battagin at Feather River Solar Electric. Call 530-284-7849, or email him at: frenergy@psln.com. Bill has his modules up over sixty feet high on a home-made steel tower. Richard Perez



"Did I ever tell you about the time I ate the grid?"

Energy Efficiency...Endless Possibilities

Although I am addressing this E-mail to Richard Perez, I hope that you will pass along my sincere appreciation for all the work your group puts into this magazine. I stumbled upon your magazine while browsing through a bookstore, and had to have the only copy on the rack. That was the March/April issue, I believe. Since you allow the free download of your magazines on the web, I have looked at a few more issues and am now a proud subscriber of your publication. I too am an armchair reader of *Home Power*, and would like to give my two-cents worth concerning this magazine.

Some have criticized you, Mr. Perez, for your opinions regarding power companies, the US Government and others, when it comes to power regulations. I, in contrast to many of the self-proclaimed armchair readers, mostly agree with the stance of this magazine.

The public has been convinced that more power and the consumption of it makes us a better nation. It does not! The US Government, power companies and others have taught us that consumption is not a problem for us to worry about as end users, but now is the time that we should change this thought. Government and corporate officials don't like to contradict themselves when it comes to information, so it's time for the public to inform themselves and each other.

When the general public sees that energy efficiency does not mean doing without and that it will save them money at the same time, people will slowly change. We all look at those monthly bills and wonder if there is anything that we can do about them, and there is. Although I rent my current home, I am slowly implementing energy saving measures that will stay with the home after I leave. Start with the standard light bulbs, switch to fluorescents when they burn out. Use less water, use a fan when it gets hot instead of, or in conjunction with, the air conditioner, consider making a meal in a home built solar oven for a weekend meal... Endless possibilities. Even if we don't live off the grid we can still start saving the planet at home. Remember, you aren't saving the planet for yourself or for the planet's sake, but for your children's and your children's children's sake.

Harry_Martin_@compuserve.com

Although I'm not completely sure about the details of this, I did have to pay for the following act of bureaucracy. Did you know that during the drought in Southern California in the early 1990s, that when people were asked to cut water consumption at least an additional 10% over the 10% they already had, that the public cut back too much and water rates went up to keep the Los Angeles DWP from losing money? I was one of those who was delivered a letter during those times stating that since consumption was cut far below what they imagined possible, a rate hike would be effective in x number of days! If that ain't government out of control, I don't know what is. LA hogs too much water in my opinion anyway, but that's a whole other matter. Keep up the good work! Dan Metcalf, San Gabriel, CA

A Lament

Gee, is it a good time to write when I'm somewhat depressed? Well, I've been wanting to write this letter for some time seeking some encouragement, so I guess now's as good a time as any...

Our helper PV system (it's a hobby, after all, we certainly don't "need" the power) has been up for a full year now! (Three BP 275 modules et. al. all from *HP* advertisers, of course). Insert the standard "I couldn't have done it without you" here, especially since it's true. Thank-you!

Now, my lament. I'm dejected about the rate of change in this world. Over and over, I've seen it in print to the effect that "The best way to help change is by being a good example." I've seen that in some of the solar catalogs and various and sundry magazines that are out to change the world for the better. I used to think it was true, but now that I have many years of experience under my belt, I don't know if I do anymore.

I also enjoy bicycling as transportation (they also use the "We're models of a better way!" comment frequently.) and it just seemed so obvious to me that the two went hand-in-hand as far as the low-impact way to live in harmony with the earth and the blah-blah-blah-hand-me-another-granola-vegetarian-tofu-love-bar thing (not to quote the good ex-President Bush, of course.)

Then came the letter from some biking fellow and the Home Power reply, which was somewhere along the lines of, "We can't/won't/don't do it, but we think that those who do are cool." That set the ball rolling. Heck, if the guys at Home Power who are like-thinking in many ways don't do the bike schtick, then why should I expect anyone, anywhere to be inspired by my model. Someone's either going to agree with me or they won't.

When I'm out there "modeling" on my bike, the guy coming up on me in the car does not think, "Gee, I'm inspired, if that big fat guy can do it, so can I!", he thinks "Damn. Another @\$% bike in my way." Even all my co-workers who know I bike/solar think this way. So I am now leaning towards a new philosophy and don't think I'm going to give a rat's behind about "modeling" anymore (sniff).

Now I think more along these lines: Peoples' behavior will change... • only if they are leaning towards it anyway • if it does not require any effort to speak of on their part • if it hits them in the pocketbook. Other than that, folks seem to spend most of their time stumbling around mostly asleep (or wishing they could sleep because they are working so darn hard all the time.)

Do you folks have any helpful hints to get me out of my cynical funk? That is, how do you guys maintain a positive attitude in the face of day-to-day experience? This isn't a "Home Power" type letter, per se, but what the heck. D Pureheart Steinbruner, Aptos, California

Hi, I think you are looking at the problem sideways. You shouldn't look at what you are doing as "modeling" but as burning less dead dinosaurs. In other words, not adding to the problem.

Here at Home Power we use PVs, wind (and as small amount of dinosaurs as possible to get an issue out) for electricity. If it wasn't for

magazine deadlines we would not even need a generator. We plan on adding hydro soon (even though it will only work for a few months a year here.) A few months ago, we finished a low impact strawbale building with solar hot water (times 2) and solar space heating. I also solar cook when the weather cooperates, which hasn't been much lately! Soon we will be adding a PV intertie system to our grid connected warehouse in town, even though most months we use less than one kWh per day there.

Currently, Home Power has nine full or part time employees. Six live on RE full time, three live on grid power. Of the three on grid power, one uses his bike or his feet in town, and one plans on adding a wind generator (intertied, of course) soon.

The reason we don't use an electric vehicle or bike is because a trip to town requires going 120 miles over a couple of mountains. We start at 3300 feet, go down to about 1800 feet, up and over a 4200 foot mountain pass to about 1800 feet again just to get to town—oh, did I mention that the first 7.2 miles is really bad 4-wheel drive adobe road? According to the electric vehicle expert that made a trip with us, we would need a minimum of two recharging garages en route to do it electric—maybe. Biking would be a full time job just to get in the "stuff" we have to haul.

Is our time better spent working on the magazine or on a bike? I suppose you could say we should move to town and then we could use an EV or a bike. Personally, I would go bonkers! Richard and I will have lived here for 28 years come September 1, 1998. Heck, I get squirrely just being in town for a day, and any big city makes me glassy eyed and three quarters brain dead. An old dog and all that. So are we living up to our philosophy, or not? Karen Perez

Hello D Pureheart. Buck up, me hearty, the situation is not as bad as it seems. People are changing. We've just gotten back from MREF, where we met thousands of them. I met a couple which spent an entire year eating only what they grew in their garden. I met many folks going off-grid and many others going utility intertie. You are not alone!

Now, a bit of psycho-philosophical drivel. The only person we can ever really change is ourselves. Others must do this for themselves. Instead of expecting "modeling" to have an immediate effect on those around you, buy a new set of tires and go for a long bike ride.... Richard Perez

A Good Scolding

I think Michael Welch deserves a good scolding for the shocking position he took in "A Green Power Recommendation" in the June/July issue.

His reasons for recommending Green Mountain Energy Resources are contrary to the idea that is the most wonderful thing about Home Power: small scale, innovative, experimental efforts by individuals to generate power are the best way to fight the environmental damage caused by conventional methods of producing electricity.

He recommends Green Mountain over the smaller, totally green energy producers like Sharp Energy because they are bigger, better organized (their advertising campaign includes full page ads in Home Power and co-sponsoring Solfest 98) and are more likely to be around for a while.

What would have become of *Home Power* if your early subscribers had decided to play it safe and read Popular Science instead of paying for your magazine? It seemed pretty risky to me to send a check to a loose collection of idealists, experimenters and ex-hippies who had set up shop on the back side of nowhere to publish a scruffy little magazine promoting the astonishing concept that anyone could generate enough of their own power from the sun and the wind and the rain to live comfortably.

I'm glad I did.

I talked to Mr. Sharp of Sharp Energy. Michael is right, his is a small outfit that may not last. In the mean time, I will be happy to give them a try. Worst case, I'll have to find another power supplier, maybe even Green Mountain.

I ask Michael and the Redwood Alliance to please reconsider and encourage people to buy their grid power from the best of the green energy sources, not just the best organized with the biggest advertising budget.

Keep up the good work, John Kelly, 428 Oak Court, Menlo Park, CA 94025 • johnk@oaktech.com

John, I appreciate your feedback. Believe me, our sentiments are on a parallel course. I firmly believe in "small is better," but in this case, there wasn't much of a choice. The small producers are too small to be able to give service to the thousands that may want them. So, yes, go with a small producer if you can find one, but really, the bottom line is to get more renewable energy sources out there to replace the dirty ones we already have.

As for Sharp Energy, after five phone calls, I finally got hold of the only person there that knew anything. We talked for about half an hour to 45 minutes. The conversation concluded amicably soon after the owner told me that they are not ready to start selling power and don't expect to be ready for some time. In fact, they are still on the CPUC's inactive list as of this writing.

In spite of that, I still gave Sharp Energy some excellent press in my article. And, keep in mind, many people would argue that a 30,000 pig "hog farm" could hardly be considered green. Sure, it's electricity from biomass, but imagine the local environmental impact of such a huge oinker factory.

Of all the small energy producers we looked at, this one was the most attractive. We stand by Redwood Alliance's insistence that our energy choice result in more new RE sources being brought on line, and GMER's Wind for the Future program comes the closest to meeting that need. The only other group that had a commitment to building more RE sources was Enron, and they dropped out of the picture. Michael Welch

Apples & Oranges: Dealers v. Installers

In response to the continuing discussion concerning prices being included in this fine magazine, these are the comments of this dealer/installer. I believe it's quite simple. There are dealers and then there are dealer/installers, it's an apples and oranges kinda thing.

Dealers make a living by retailing large volumes of equipment. Dealers are retailers. Generally, they have little or no experience with the use and installation of the products they are selling (relative to the dealer/installer). Dealers have not invested thousands of dollars in the tools necessary to install RE systems. Dealers have not invested the time and money to acquire a license, bonding, insurance, and hands-on experience necessary to safely install systems in the real world. I also feel it is significant that a much higher percentage of dealer/installers live with RE systems every day at our homes and businesses.

I remember a call we recently received from one of our customers whose inverter was 'terminated' by lightning. She called me at about 6 PM in the evening. The next morning at 8 AM, I was at her door (~100 miles away) trouble shooting, leaving her 'online' w/ the generator until the new inverter arrived. You bet I charged her more for the inverter than a dealer at SolarMart would have. Of course, the folks at SolarMart were still in bed when I was driving to my customer's home to fix her system. Apples and oranges.

Don't get me wrong, there is a place for the dealer (only) in this world, but please don't expect me to compete with him/her at the cost of hardware level. The dealer is not my competition (in my mind). The dealer pays less because he/she buys in volume, an old axiom in

capitalism. I tell people who are price shopping on the phone that I cannot compete with the hardware dealers, and I politely refer them to my favorite dealer. This doesn't bother me at all...we sell oranges.

People need to know that small dealer/installer businesses like ours pay more for exactly the same RE gizmo as does the volume dealer...we literally cannot compete on just the basis of hardware prices. Yep, I charge more for the same products...Arrogant? Condo in Colorado? Gouger? You decide. Personally, I am proud that my installations are durable and safe, that my customers can call me with a problem and have it solved promptly, that my customers feel they can call to ask me questions anytime (even after hours) about their system. We sell and stand behind much more than just hardware, we are dealer/installers.

Enormous thanks to *Home Power* for the opportunity to undertake this discussion, it's a good thing that all this is aired out. Bill Battagin, Feather River Solar Electric, frenergy@psln.com

Gravity Siphon DHW Safety

Thanks to Bernard Edl (*HP 65*, Letters) for emphasizing the importance of pressure safety with the gravity siphon solar water heater. He graciously discussed his concerns with me in detail, which led to further research. The points in his letter are addressed in order below.

Mr. Edl explained that brittleness was a big problem when plastic pipe was first introduced for hot water. My local manufacturer's representative for Genova CPVC pipe confirmed this, but said it had been a different kind of plastic. He thought that compressed air at only 50 psi would be no problem for CPVC, and offered to contact Genova engineers. My own test with pliers demonstrated that CPVC is tough and deforms without fracture, both at 70°F and 212°F.

A company engineer explained that the CPVC rating curve includes a whopping 400 psi at 73°F and 80 psi at 200°F, i.e. good news that the nominal 180°F rating is not a limit at low pressure. However, he said cracking can occur at very low temperatures, even though the plastic actually gets stronger. A piece of CPVC pipe left in the freezer at -10°F was strong and rigid with my pliers. Crushing it flat in a 1-ton press resulted in cracks, but not shattering. The Genova folks also cautioned that long term direct sun exposure can cause brittleness.

The engineering reality is that CPVC is not rated for air service because of the small chance of a flaw which could initiate cracking. They worry about customers using long lengths of CPVC pipe to convey 150 psi compressed air in freezing climates. A flaw is less likely if less plastic is used, as in the short adapters of my Gravity Siphon prototype. Lower pressures in a freeze-protected room reduce the likelihood of cracking even with a flaw. Finally, lower pressures and short lengths greatly reduce the consequences if the plastic should break.

Mr. Edl was very observant in noticing the T&P valve which came with the air makeup tank in my published photographs. If the collector could perform well enough to deliver water above 210°F, the T&P would open to increase flow and provide immediate cooling. It would work the same upside down in a small tank with continuous flow, since thermal layering is insignificant.

T&P valves exist to protect water heaters against unlimited energy input from a flame or electric element that fails on. Water expands 4 percent when raised to its boiling point. This can generate arbitrarily high pressures in a confined liquid, but not with the air buffer of the gravity siphon. Pressurized water much hotter than its atmospheric boiling point is especially dangerous, as stated in Mr. Edl's letter. It will "flash" to make large quantities of steam if released by a rupture.

In the case of solar heaters, the energy input is physically limited. Collectors become very inefficient at steam temperatures. Continued heating on consecutive vacation days is possible with other solar heaters, but temperatures are still limited. The gravity siphon system

has additional inherent limits, e.g. energy can't be added to a full hot tank.

Data from SRCC (Solar Rating and Certification Corp) indicates that even the best 4x8 foot collector won't fill a gravity siphon 50 gallon tank anywhere near 210°F. Higher temperatures may be reached at flows way too low to fill the tank in a day. Late afternoon flow would then have a cooling effect. Any steam would carry heat away by rising, then condensing in the air pipe or cold tank. Given all the physical energy limiters, deadly steam explosions of the gravity siphon system are not a realistic possibility.

Regarding compressed air in their tanks, water heater companies are mainly concerned about heating elements burning out, or excessive flue temperatures if these parts run dry. While there are no such hot spots in the gravity siphon system, the companies have no reason to provide an air rating. The pressure levels and high safety factors noted in my second article (*HP 64*) match those of standard well pump tanks which do contain compressed air. For perspective, 50 gallons of air at 50 psi releases 20 Watt-hours of energy upon expanding. Rapid venting could overpressurize a small sealed room. However, the energy is below one percent of that associated with scalding steam explosions, which do occasionally happen with regular water heaters.

In spite of the numbers, I do agree with Mr. Edl that weakening of tanks by rusting is a concern. He told me that his leak test explosion started at a rusty spot, then split the weld along the length of the tank. Happily, he also informed me that weld quality has increased tremendously in recent years. There is other good news from State Industries, the maker of the Reliance brand tanks shown in the articles. Plastic lined electric water heaters are here to stay. They are very rust resistant without anode rods. Furthermore, they are made of half shells with a girth weld, which is fundamentally twice as strong as a weld along the tank length.

In summary, using CPVC is a reasonable judgement call for a few short adapters containing air well above freezing. Verify that peak temperatures on the hottest days are below boiling, and include the T&P valve. Provide ventilation if tanks are in a small room. Most importantly, please do not build a gravity siphon system with old rusty tanks! Modern plastic lined tanks have the configuration shown in Figure 2A, *HP 64*, p. 27. John Whitehead, Davis California, jcw@dcn.davis.ca.us

Oops

We are all dumbfounded that the AMPAIR missed being included in the *Home Power* wind generator article (*HP 65*). Furthermore, the insinuation that any manufacturer not included is not "bona fide" or "has failed", or are other than "successful", is a low blow.

The AMPAIR 100 has been advertised in *Home Power* for several years. It has been advertised in the major Marine publications for more than 15 years. The current version has been in production for about 10 years. It is made in the UK, and we have been the sole distributor for the manufacturer in the USA and Canada since 1983. Our marketing has been primarily to the Marine Industry. There are about 10,000 of these machines in service around the World today, at sea and on land, from the far North to the Antarctic.

It seems that Mick Sagrillo really did not do his homework. He missed the best wind generator on the market. He didn't even call to request literature or to discuss the unit. The quality of the AMPAIR is probably better than any of those shown in the article. When you see it, you will appreciate the rugged construction.

AMPAIR is a simple, well engineered machine, made of robust cast aluminum and stainless steel, with 6 fiberglass/polypropylene composite blades in the 36" rotor. It has a permanent magnet alternator. It also does not require a mechanical brake or thermal limit switch to cut off current production and prevent damage from

overheating in high winds. This unit does not make any noise. AMPAIR provides continuous amperage no matter how hard the wind blows.

AMPAIR is the *only* one that has a chance to stand up and operate in heavy air. This is what yachtsmen who have survived hurricanes tell us at the boat shows. This is what the project engineer at the National Oceanic and Atmospheric Administration (NOAA) told us about the one they used on the Argentina Expedition in Antarctica in 1993. It was on a tower at 63.24S/56.59W where the winds are fierce. NOAA tried many of the others. AMPAIR outlasted them all!

Mick, would you like us to send you information on this machine? Sincerely, Jack Csenge, President, Jack Rabbit Energy Systems, Div. Jack Rabbit Marine, Inc., 425 Fairfield Ave., Stamford, CT 06902 • 203-961-8133 • Fax: 203-961-0382 Email: JackRabbitMarine@compuserve.com

Hello Jack. I'm sorry, we goofed. Even though this latest version of Mick's Apples and Oranges doubled the number of wind gennys covered, we missed yours. I met Hugh Piggott for the first time at this year's MREF. He came all the way from Scotland to attend the fair. Hugh had glowing reports of the AMPAIR units he'd seen running in Scotland. Rest assured, we'll include the AMPAIR in the next version of Apples and Oranges. Until then, we have printed your letter with the AMPAIR specs. Richard Perez

PowerPulse® Clarification

I was happy to see the positive comments from Richard Perez concerning the PowerPulse® battery maintenance products (*HP 65*, Letters). One or two points in Richard's remarks are in need of clarification, however.

The PowerPulse® name is a registered trademark that should not be used generically. In order to respect the manufacturer's trademark, the superscripted R registration mark should be used.

When Richard speaks about "early failures in the product", *HP* readers should be aware that he is not referring to PowerPulse®, but to similar products sold under different names by different companies.

In my experience, the PowerPulse® failure rate is less than one-half of one percent. The failures that I have observed are usually cases of "infant mortality", in which a relatively new unit stops blinking. (Once or twice these failures were related to excessive battery voltage, especially on the higher voltage units.) The manufacturer has typically authorized me to exchange defective units over the counter, so product support is strong.

I am pleased to introduce this product to *Home Power* readers, and I agree with Richard when he describes these devices as "standard equipment for a lead-acid battery system." Mick Abraham, Abraham Solar Equipment, Pagosa Springs, Colorado

Courage & Conscience

Greetings Richard, We congratulate you on placing Che Guevara's photo & his words which had a heavy impact on us. There is absolutely no need for you or Karen to feel that you should apologize for publishing his picture & famous words! He is a man who simply could not sit idly by and allow tyrants to murder, terrorize & exploit the common people!

I suppose those who chose to criticize you probably find nothing wrong with the US Govt conscripting young Americans, giving them a gun & horrendous weapons, & sending them 10,000 miles to kill Vietnamese who were absolutely no threat to the USA or to other nations, as history has shown.

Back in the late 1930s, when Dictator Francisco Franco & his Fascists, & (German & Italian Fascist allies) were waging war on the Democratically elected "Loyalist Government of Spain", the "Democratic" nations refused to help. They even blockaded any aid

from reaching the heroic loyalists who were doing the very best they could against the superior & modern weapons of the fascists.

But there were people with courage & consciences who felt they could not sit on their fannies & wring their hands, or sit in their easy chairs smoking their pipes & pontificating from on high! They formed Brigades of Volunteers & set out for Spain from many countries—"The International Brigades"! The Abraham Lincoln Brigade from the USA, & "The Mackenzie Papineau Brigade from Canada, & so forth.

A world famous Canadian Doctor, Dr. Norman Bethune, also volunteered to serve. At great risk to his personal safety, he was the first Doctor to develop & bring Blood Transfusions into the battlefield & saved many lives. (Get the book *The Scalpel, The Sword* by Ted Allen et al). This book details his free Med Clinic for the poor in Montreal, his clash with the Medical Establishment over TB & his attempt to implement Preventive Measures, his service in Spain, his incredible service in China (Manchuria) during the struggle to drive out the Japanese Invaders, & his heroic death. There is a white marble statue of Bethune in a valley, surrounded by 40,000 white marble tombstones of the Chinese People's Army!

At a Chinese Scientific Research station in the Antarctic about a year ago, a Canadian ship had to put in for shelter. As the Canadian ship approached & the Chinese could see our Canadian Flag, they chose to greet the Canadian ship with one word, "Bethune!", which rang out over the water! This is over fifty years after his heroic death in China. They felt that his "name" alone would be the most appropriate greeting to Canadians. Back then, they insisted that he accept a General's salary of \$35.00 per month plus uniform, & food, and apologized to him for it being so small. He refused to accept it, and when they insisted, he simply turned around & donated it to the soldier's fund in the hospital.

Che Guevara belongs to a special breed of human beings like Dr. Bethune, and the International Brigades who bravely attempted to stop the march of Fascism which later overran all of Europe. I am convinced that Che Guevara, The International Brigades, and Dr. Norman Bethune yearned for peace & justice in the world much more than those who stood by & tried to 'nitpick' them. It takes great courage to volunteer, to enter the valley of death, & put your money where your mouth is.

Richard, we also have great respect for you, in your placing that picture of Che & his famous words, knowing full well that it would make you a 'lightning rod' for all of the paranoid right-wingers. I have been a charter boat skipper in a large steel cruiser on Nipigon since 1953, & have had many American parties of 8. We learned an American saying from them. "This is what separates the men from the boys". This applies to you, Richard! As far as business \$\$\$\$ is concerned, that photo of Che was the last thing any dollar thirsty businessman & Editor would place in a magazine.

Viva Che Guevara, Viva Fidel, Viva Richard Perez, & Viva to *Home Power* For The People! We wish you & all the good people of *HP* well, & even greater success! Doug & Julie Townsend, Northwest Windpower Systems, Mud River, Via Armstrong P.O., Northwestern Ontario, Canada POT 1AO, Located on CNR Main Line North of Lake Nipigon, Phone: (807) Mud River 0122 (Operator Assisted)

Hello Doug & Julie. Many thanks for the kind words and the revolutionary perspective. I guess I was into politics before I got into energy, but I now know that the two are really inseparable. Check out the quote from Luis Berriz on page 52 of this issue. Richard Perez

Interested in RE

I am a sixth grade math teacher from Houston, Texas. To make a long story short, I have always wanted to do something in this world where both others and I can benefit. That's why I teach. The problem is that while I wake each morning not dreading the work that faces me, teachers make a marginal income compared to other professions. I

want to augment my income with another endeavor that I think is not only important, but interesting.

I have been interested in RE for some time, but did not know what direction to travel in until I stumbled across your magazine in a bookstore. Without a doubt, this is what I want to do. I am not really sure how I want to approach the acquisition of knowledge. My goal is to become a part-time teacher in some small town on the outskirts of San Antonio or some other community that has market potential and sell and install PV and wind generating electricity units in people's homes and businesses.

My thought is to work towards an electrician's license and specialize in the the field of RE with the ability to wire houses as a business. I am enrolled in the Industrial Electricity Program at Houston Community College. My first two courses this summer are: Introduction to Electricity and House Wiring. If possible, I would like your feedback on this, if it seems a wise path or what other things I should consider in my preparation for this field. Thank you, Noyes Livingston, Houston, TX

Hello Noyes. You are already on the right track. I'd recommend spending some time at Solar Energy International (SEI). Check out their ad in this issue. SEI is a great place to get your hands on a variety of RE hardware in actual working systems. Hands-on experience, coupled with the courses you are now taking, will give you most of what you need to get started in the RE business. Richard Perez

SolWest Renewable Energies Fair 1999

Dear Richard, Karen, and the Home Power Crew: It was fantastic to see you all at MREF in Wisconsin last week. What a wonderful, positive experience! Those folks are the greatest. I came home inspired to plan more features for our own SolWest Fair, which will be happening in John Day, Oregon in July of 1999.

The Eastern Oregon Renewable Energies Association (EORenew) had our organizational meeting in early June. We invite all who are interested in learning about and promoting RE in our region to join. Dues are a reasonable \$10/individual and \$12/family. Jennifer Barker, EORenew/Solwest Fair • PO Box 485 • Canyon City, OR 97820 Email: solwest@eoni.com

Jennifer, It was great to see you again at MREF. We're really looking forward to the Solwest Fair. Richard Perez

Solar2 CD ROM Fan

Just got my Solar2. Amazed. Major, major congratulations are in order to the entire HP crew, especially to whoever did the CD ROM.

I just wanted to say that the quality, care to detail and amount of work involved is really obvious to anyone with a computing background. The whole thing is just brilliant; cross-platform, well laid out, easy to use, indexed, minimally/renewably packaged. A case-study of how to distribute info. I just can't believe how good it is. The index alone is so useful. Brilliant! Put me on the list for Solar3! Ben Gabel, Cambridge Light & Power Limited, beng@camlipo.demon.co.uk

Hello, Ben. We're glad you liked Solar2. The credit for this CD-ROM's production goes to Don Kulha who spend hundreds of hours organizing and processing the material. And he did an even better job with Solar3. Solar3 is now on sale—see the ad in this issue. Richard Perez

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We all think your magazine is one of the best, and has a ton of information. What do we at ASEA need to do to be able to utilize some of it? We don't want to infringe on anyone's copyrights. If it is OK with you, we will also make copies of your Subscription request and hand them out at our meetings and events. Jim Miller Director of Events, Arizona Solar Energy Association Email: jmiller@swest.dcmdw.dla.mil

Hello Jim. You bet, copy those sub forms and hand them out. In fact, we generally allow any not-for-profit venture to use and reproduce the material in Home Power. Richard Perez

Renewable Energy Co-op

Dear HP folks, wow—*HP 64* sure was full of stuff that fired me up! In the articles IPP (pp. 76-78), Power Politics (pp. 86-88), and several of the letters (also elsewhere in *HP 64* and in nearly every other issue) the “Us against Them” nature of the RE struggle is expounded upon in considerable detail.

I am wondering if anyone has ever thought of the possibility of uniting the RE producers, users, would-be users, and sympathizers in a nationwide (or preferably, worldwide) co-op or closely integrated family of co-op businesses. Such a co-op or family of co-ops could conceivably purchase renewable energy from residential RE systems when they were producing a surplus, and from other RE power producers of any size. The co-op could sell to residential consumers, and be responsive to the needs and wishes of its customers—the same people that would be its owners. Such a business (or family of businesses) would not only unite the voices of the pro-RE community, but would lend it considerable credence by being a commercial enterprise which could lobby for its own economic well being, rather than “merely” being an advocacy group pressing for supposedly liberal, anti-market, anti-American policies.

It seems to me that if ya can't just beat 'em, one should join them on one's own terms and then beat 'em.

I realize that to do something like this would require a lot of details to be worked out. But to continue promoting RE in the same manner as is currently being done also requires constant working out of details and seems to me to be considerably more haphazard and susceptible to political whims, popular fads, and economic circumstances than confronting the obstacles to RE, united in a business. And a co-op is the only kind of business which could realistically meet our needs and desires—though it would not, necessarily, need to be a “non-profit” in the tax code sense.

If any *Home Power* readers think there is anything of value to this suggestion—or that anything of value could be made of it...well, let's do something about it! I don't care whether anyone wants to take this idea and run with it without me, or with me. But I sincerely believe that the best course lies in this direction.

Additionally, I would like to get to know some of the pro-RE people in the Bend, Oregon area. Please print my contact info, just in case anybody around here would like to get in touch with me. And thanks for a WONDERFUL and truly important magazine! Richard & Patricia Richardson, 60947 Gosney Rd., Bend, OR 97702 • 541-388-3781 Email: RRR112157@aol.com

Solar Products from P.R. China

Dear Sir, we are the manufacturer of solar products here in P.R. China. We will be grateful if you can introduce our companies to your members in your country about our business and we will be very pleased to do business with your esteemed members who are importers or distributors/wholesellers for our products. We manufacture and export the following products: solar panels, solar lanterns, solar garden lights, solar cooling caps, solar chargers, solar power inverters, solar power systems for offices, houses, etc. We believe the above products will be welcomed by your members, since all of these products have the same advantage: saving energy.

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900 MHz Cordless Phones

Hi Richard et al, Just received *HP 65*. Here's an addition to the Q & A item on page 109: One easy source for off-the-shelf 800-900 Mhz antennas (Yagis, Omnis, etc.) is RadioWare, www.radio-ware.com or 800-950-WARE. They have quite a selection...I have no connection with them, but have ordered stuff and find them OK. 73, Warren Munro, KH6WM • Email: wmunro@lava.net

Love the web site!

I just had to drop you a quick note to congratulate you on a terrific web site. It is full of worthwhile information and plenty of incentive to get out there and do the right thing for the right reasons.

As a former subscriber, I have missed the magazine greatly as of late. Since going back to school full time, my wife and I have found it necessary to cut back on anything that could possibly be considered to be a luxury. Magazine subscriptions fell into that category for sure. But I just downloaded the electronic version of *Home Power*, and I can only say that I thank you for offering something so valuable for nothing. A rare thing today, if not ever.

Believe me when I say that your tendency to put your money (and spirit) where your mouth is will absolutely guarantee that I will be back as a subscriber in the not too distant future, as I once again become a member of the employed work force of America. And, due to your work, I will find it that much easier to put an RE system to work here at home, even on a small scale—only to get bigger and more worthwhile over time. Thanks a lot, I really appreciate the access. Greatful reader, Jamie Beckett • Email: JFBECKETT@aol.com

Hello Jamie. Thanks for the flowers. We try hard and it's wonderful to be appreciated!

We are keeping the download of our current issue free. We are doing this for many reasons. Job one here is to spread the info. If we charged for the download, the major cost component is actually the act of charging money—our processing time for a credit card order. So we're going to keep giving it away.

And, wouldn't you know, we are actually making money by giving it away. Over 41,000 people downloaded the last issue. This has effectively tripled our circulation in a period of four months. Our advertisers are deliriously happy about this, and they are buying bigger ads. Also, companies which have not advertised in the past are signing on. We haven't raised our ad rates, and we are not going to.

We welcome you back as a reader. Keep on downloading the issues. When you go back to work, you can either re-subscribe to the paper version, or not. Many of the folks reading the free electronic edition have transferred their paper sub to their local public library. Richard Perez

HP Ads on the Net

Richard, I just wanted to let you know I appreciate the fact that you distribute electronic copies of your magazine for no charge. I read the answer to a letter in ITALICHP 65END-ITALIC where you indicate that advertisers are charged a small premium to appear in the electronic version. The main reason I downloaded the issue was for the advertisements, though the articles were interesting as well. Your advertisers are certainly getting value for their money, and I hope you can continue this method of cost recovery. Allan Yates
Email: ayates@nortel.ca

Hello Allan, because we have been giving Home Power away for free on the web, our ad revenues have increased. We are going to keep the downloading for free and we are NOT even going to charge our advertisers an additional fee for being in the electronic edition. Our increased ad revenue due to increased circulation means we are no longer losing money giving the electronic edition anyway, but are we

are actually making money by giving it away. Isn't the Internet wonderful? Richard Perez

Green Web Service, Soon

I finally found an excellent resource for solar power. Your mag. is great! And it really impresses me when a company supplies their entire mag. for free over the net. I have been wanting to start using solar on my home for years, but could never find any information for do-it-yourself stuff.

I have a home office where I run my internet business. I have three computers, two of which are my internet servers. I hope to have this office completely solar powered within five years. I would then be able to advertise the fact that I run a "green" web service/hosting company. I would then interface my database engine on my server with the information coming off an E-meter or some other device. This way, people could see how much power the solar grids were generating via my web site 24 hours/day. It would also be a good way for me to do remote monitoring. If possible, I also hope to install a separate A/C unit to run off solar.

It amazes me that everywhere technology is increasing at leaps and bounds, but solar technology has been kept in the closet. But I know one thing, with the internet at our fingertips, no longer will solar-power be an expensive hard to find option for the average homeowner. Thank you again for a great magazine. I have been forwarding your website address to many of my friends. Kevin, WebPulse, www.WebPulse.com

Power's Out, but the Lights are On

Dear Mr. Perez, I thought you might find it interesting that while we are having a severe thunderstorm and the power is out, I am still able to write this as it happens. My system is comprised of a 64 Watt Uni-Solar panel, two 105 A-h Marine Deep Cycle batteries, and a small 330 Watt generic inverter. This small system powers my two computers and their network, my stereo, and lights all at once. Whoever said that RE meant going without! Anyway, keep up the great work you do, and keep those issues a-coming. Thanks for listening, Andrew Durst, Slakjaw@aol.com

Hello, Andrew, AW REET! This RE stuff really shines when the grid goes down! Richard Perez

The Burbs

I'm writing from the burbs of Augusta, Georgia. Georgia Power of the Southern Co. sells us electricity, rather cheap (for now, anyway). Basically, it is always 1959 here in Martinez, GA. Our SAPs (Southern American Princesses) run their 2000+ Watt hair blow dryers, straining the five-ton central air conditioning units. We all drive push rod V8-powered Explorers or Suburbans, and take two vehicles to the pool so one can leave early. There is one house in Columbia County, Georgia that is solar passive and has solar hot water. It's not mine, either—my neighborhood association would not allow collectors in sight. Basically, your publication is a fresh breath of sunshine in more ways than one. I used to ride my bicycle to work every day. That's before I became a soccer/Little League Dad. The only time solar or renewable energy gets mentioned is on "Earth Day." This is the day that 3rd graders do things with oatmeal boxes. Keep up the wonderful work and we'll always keep the light on. Larry Komp, Martinez, Georgia



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Richard Perez

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Midwest Renewable Energy Fair 1998

Well, for the ninth year in a row, the Home Power Crew attended MREF. Every year this fair gets bigger. Every year it gets better. If you were there, then you already know this. If you weren't at this year's MREF, then put it on your summer schedule for next year.

There is nothing like the Midwest Renewable Energy Fair anywhere on this planet. This year, over eleven thousand folks from 49 American states and 30 foreign countries attended. This is the truest testimonial to the effectiveness and value of MREF. Just spend a moment to consider why people would come from all around the world to visit the little town of Amherst, Wisconsin. From our perspective, we met old friends, made new friends, chewed the fat with Industry Biggies, and discussed the biz with Mom & Pop solar companies. We saw some new and wonderful technologies. See the article on page 32 of this issue for a view of some of MREF's activities.

Most of the Home Power Crew went by road again this year. Six of us—Joy, Ben, Don, Michael, Karen and I drove in a rented RV. Bob-O and Kathleen flew in an airplane, which may be the plan for all of us next year. The RV journey went well. It took 52 hours of driving to get to Amherst, Wisconsin and 48 hours to return. I guess last year's RV trek made us better RVers. We had few problems with the 31' Ford Class C. It rode better and was easier to drive than the 30' Chevy we rented last year. A big plus was that this year, everything on it worked. Last year, we rented from a nationwide outfit and the RV was in poor repair. Most of the coach stuff was already broken or on its way out. This year, we rented from a local outfit. It was much cheaper and everything functioned. With most of the Crew getting on in years, the continual driving was hard on our bearings. Since we couldn't afford the time to stop at night, we drove in shifts, stopping only for food and fuel.

I'm happy to report that I don't have any disaster tales to tell about this year's road trip. I appointed Don Kulha "Captain Trips." Don is an experienced RVer with over 40,000 accident-free miles to his credit—he helped to keep us safe on the road. We only had one near miss when Bambi gave Ben a scare in the middle of a Montana night. Ben hit the brakes hard and missed the deer, but all of us woke up and were ready to abandon ship.

One of the big compensations of road trips is that the Crew gets to eat out—and this group is really into their munchies. Since we were more experienced in driving the big rigs, we decided to venture off the beaten path in search of something other than greasy truck stop food. Success—we never even nosed the RV into a place where we had to back out. Our daring navigation into the cities was rewarded by some really good eats.

Here are the Road Crew's top picks for munchies along the road to MREF: First off, Mary Lou's Cafe in Neillsville, Wisconsin still gets the coveted "Top French Fry" award. If you like Mexican food and are in Fargo, North Dakota, then stop at the Mexican Village—great mounds of great food. Finally, in Coeur d'Alene, Idaho, we found an authentic Japanese restaurant by the name of Takara serving wonderful sushi. While in Amherst, Wisconsin, the breakfasts are great and inexpensive at the Frontier. Dinner in Amherst was at our usual stop at the Tomorrow River Inn—a favorite watering hole for MREF attendees since 1990. All of us put on a few pounds, which points out another advantage of flying—no one eats airline food.

We all had a wonderful time on this road trip, but I think we may fly next year. It would be nice to arrive at MREF as a state other than dog-tired. While I'm no fan of commercial air travel, I must admit that it's quick. I'm also feeling guilty about the over five hundred gallons of gas we used to get six of us to MREF and back. I know that it must be more fuel-efficient to fly.

Guerrilla Solar

One of the hot topics at this year's MREF was guerrilla solar. I was bombarded with questions, so I thought I'd do a little guerrilla solar Q&A right here.

First, let's define it. Guerrilla solar is a utility-intertied PV system comprised of two PV modules and the synchronous Trace MicroSine inverter. The system is simple—just wire two modules in series to make 24 VDC, then attach the MicroSine inverter. Plug the MicroSine into any wall socket, and you have an instant utility-intertied PV system. Now for the Q&A:

Will the guerrilla solar system work when the grid goes out? No, the guerrilla solar system uses a synchronous inverter and has no batteries. When the grid goes down, so does the guerrilla solar system.

Is installing a guerrilla solar system legal? Well, I'm not a lawyer, and these laws vary from state to state, but I'd have to say that installing a guerrilla solar system is probably not legal in most states. Since when did guerrillas start worrying about the legality of their revolution? A guerrilla system could be legalized by notifying the utility and going through the miles of red tape they will place in your path. But really, the point of guerrilla solar is just doing it. Since the guerrilla systems are synchronous, they present no hazard to the utility people working on power lines. This guerrilla is nonviolent and nonlethal.

Will a guerrilla solar system turn my utility electric meter backwards? Yes, if all loads in your house are off and the sun is shining, then your electric meter will run backwards. The only exceptions to this would be with folks who are saddled with a detented (unidirectional) utility electric meter or with one of the new electronic utility meters. Both of these types of meters are specifically designed NOT to run backwards. Does this tell you something about the intentions of our utilities?

Will a guerrilla solar system save me money? No, it won't. Consider this—the cost of a guerrilla solar system is about one thousand dollars. In most good solar locations, it will make about 0.5 kWh daily. This displaces about \$0.04 of

utility power per day. At that rate, the guerrilla solar system will pay for itself in about seventy years. While 0.5 kWh per day doesn't sound like a lot of energy, it is enough to power the lights in most homes.

Why should I put up a guerrilla solar system? The goal is to let a little sunshine into our lives and maybe put some of this sunshine onto the local utility grid. The goal is to counter the utilities' opposition to having *our* sunshine on *their* grid. The goal is to avoid all of the utilities' red tape which stops us from sharing our RE with our neighbors. The ultimate motivation to do this? Because we *can*.

Oregon Net Metering

We are organizing a net metering bill in Oregon. I've been surprised at where our support is coming from. I expected big solar organizations to be backing us to the max. Instead, they seem more concerned with protecting the "rights" of utilities and their political image in Washington, D.C. Support for this proposed Oregon bill is coming from rank and file folks, local solar organizations, and makers of home power equipment. One example here is Mike Bergey of Bergey Windpower. Mike contributed \$250 to help push this proposed bill through.

To solicit support for the Oregon net metering bill, I contacted over seventy current *HP* readers in Oregon via email. Actually, we have well over 500 readers in Oregon, but I only had email addresses for seventy or so. When I sent this mass mailing, I cringed. Would I be condemned for spamming? Instead, many folks responded with support. The responses ranged widely. We received donations, offers to circulate local petitions, input on the wording and intent of the bill, and comments such as, "I'm interested, keep me posted." Not one spam complaint!

In less than two months, we should have a very firm idea of what this proposed Oregon bill will contain. We still need more support. We need contributions, folks to circulate petitions locally, and general brainstorming. Please see the Access section at the end of this article for links to participation. No, you don't have to live in Oregon to help. The lessons we are learning can be applied to any state. Join in and get prepared to foster net metering for RE systems in your state.

Perhaps the most amazing thing about organizing for this bill is our new tool—email. I started doing political organizing in 1965. I've worked with the likes of SNCC, SDS, and SWP (If you don't know what this alphabet soup means, you really don't need to). I have spent hundreds of hours on street corners handing out the leaflets we stayed up all night printing. I've done the stuff, lick, and stick on tens of thousands of envelopes. Technology and the times have changed political organizing just as much as they have changed energy technologies. Email is a more effective tool for political change than either the Krasnikov AK-47 rifle or the printing press....

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Here's what has happened. Giving *HPEE* away on the net has tripled our circulation. This has made our advertisers so happy that they are buying more and bigger ads. The revenue from this has paid for *Home Power* distribution on the net. So, *Home Power* is back where it started over ten years ago—giving it away for free. Only this time, we don't have to pay for the dreaded three P's (Printing, Paper, and Postage). This time, the venture is making enough money to make giving *Home Power* away sustainable. My only real fear is that by giving it away on the net, we may lose paper edition subscribers. I have always felt that the readers who need *Home Power* most, view the current issue using a kerosene light or a candle. We are dedicated to a printed edition, and you can help by maintaining your subscription.

Access

Author: Richard Perez, Home Power, PO Box 520, Ashland, OR 97520 • 530-475-3179 • Fax: 530-475-0836
Email: richard.perez@homepower.com
Web: www.homepower.com

Written on 3 July 1998 at Funky Mountain Institute
(42°01'02"N • 122°23'19"W) using solar & wind power.

Oregon net metering bill: Richard Perez (see above) or Oregon Solar Energy Industries Association, David Parker, President, 399 East 10th Avenue, Eugene, OR 97401
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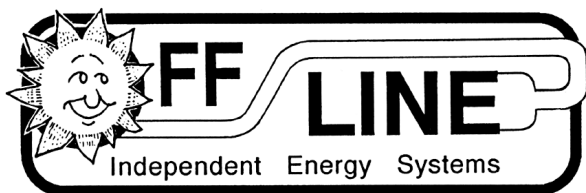


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#1 through #60 are available on the Solar2 & Solar3 CD, or borrow from a friend.

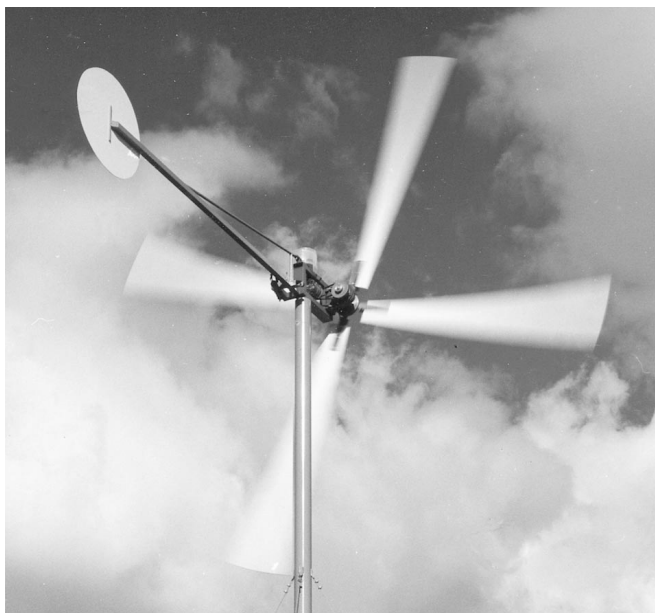
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Q&A



Above: one of José Manuel B.B. V. R. Revés' home-built wind generators.

Wind Genny Alternators

I spend my free time designing and building experimental aircrafts. I'm the mechanic, engineer, & pilot. Last year, I built and designed a wind pump which works very well. I also built a wind generator with a car alternator. However, speed regulation is a nightmare. I need another type of generator.

I need a cheap permanent magnet alternator (0.5 to 1 kW), or plans to build one. Either that, or information to build a controller to use an induction generator. If possible, please help me with information from back issues, or sources to get parts. After the wind generator is working, I can share the whole design with all interested people. Best Regards, José Manuel B.B. V. R. Revés, Beja, Portugal

Hello, José. As you have already discovered, car alternators do not work well in wind generators. Car alternators are designed for high speed operation—over 5000 rpm. Wind gennys rotate much slower—usually much less than 1000 rpm. Alternators used in wind gennys have multiple poles—usually three to six. Wind genny alternators are usually much larger in diameter which provides higher output at slower speeds. Most of the small commercial wind gennys are now using super-intense permanent magnets on their

rotors. These wind alternators are especially made for wind service and you are not likely to find one surplus or cheap. I'd contact the makers of small wind gennys, such as World Power, Southwest Windpower, Bergey, AeroGen, and others, and see if you can buy one of their alternators. If you want to build it yourself, then the best place to start is this web page: www.onekw.co.nz...Richard Perez

Charge Regulation

In the near future, I plan to obtain a bicycle lighting system with a 6 Volt gel cell. I would like to recharge it using solar cells. I was wondering if a mere blocking diode would suffice, or if more charge regulation is required. Would you have any ideas or reprinted articles along that line? Tim Ellsworth, Fort Wayne, Indiana

Hello, Tim. If you don't park the bike in the sun for days at a time, the blocking diode will do the job. Wire the whole thing up, and keep an eye on the battery's voltage during the first few weeks. If it spends a lot of time above 7.1 VDC, then you are not overcharging it badly. Use a 6 VDC module which has a current output that is no larger than 1/20th of the battery's capacity. If you use a higher current module, then you should install a regulator. See HP 38, page 33 for a schematic of a simple to build and very rugged regulator for small gel cell systems. Replace the resistor network between the Adjustment pin of the LM317T and ground with a 2 kΩ potentiometer. This will allow adjustment to a voltage limit of about 7 VDC. Also, consider moving the system up to 12 VDC. The gel cell would be no larger, and you would have a wider choice of PV modules. This would also add utility to the system—it could also power small 12 VDC electronics. Richard Perez

PV Panel Voltage

I recently bought a bunch of really old PV panels. They look to be from the late 50's or early 60's, and still produce electrons just fine. Try that with a nuclear power plant! My question concerns the voltages that these panels produce. I have two types: one has 20 cells in series, the other has 46 cells in series. The cells are 2 in. in diameter. I figure that they produce about 9 V and 21 V, respectively. Are the tolerances on inverters, controllers, etc., large enough to accommodate the higher 18 V (e.g., 2 panels wired in series $\times 9 \text{ V} = 18 \text{ V}$) and 21 V, or should I expect problems? Also, what about PV-direct applications such as pumps? Erik Sleuwenhoek, Boulder, CO

Hello, Erik. Well, each PV cell produces a voltage of around 0.45 VDC. So, 20 cells connected in series will make about 10 VDC, and 46 cells in series makes about 21 VDC. However, a PV module can never produce more than it's short-circuit current. PVs are

generally considered to be constant current devices. What this means practically is that a module will never deliver more than its short circuit current into a load. If you hook up a hot rod panel (such as the 46 series cell module you have) to a battery, then the PV panel's voltage will instantly drop to that of the battery. We routinely use hot rod modules here (we have seven, 44 series cell, Kyocera modules). Their open circuit voltage can go as high as 24 VDC. We feed them into a 12 VDC battery and all that happens is we get near maximum current.

You should have no problem with your old modules. Just wire up two 20 series cell PV modules in series, and feed this to a 12 VDC battery. You can connect the 46 series cell modules directly to the battery. Since you mentioned 2 inch diameter cells, I suspect that the modules will produce somewhere between 1.0 and 1.75 Amperes DC. Once they are wired into the battery, their voltage will drop to that of the battery. You'll have no problems with other gear such as 12 VDC appliances and/or inverters.

The situation is much the same with PV-direct applications such as pumps. All of these set-ups now use a buck converter to condition the power before feeding it to the motor. If the array supplies but does not exceed the current demands of the motor, then there will be no problems. This is true even if the power was not conditioned. Remember, PVs are basically constant current devices. Richard Perez



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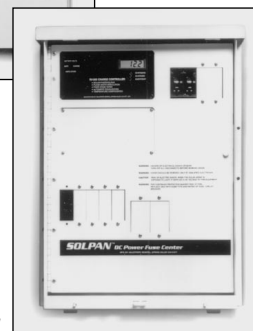
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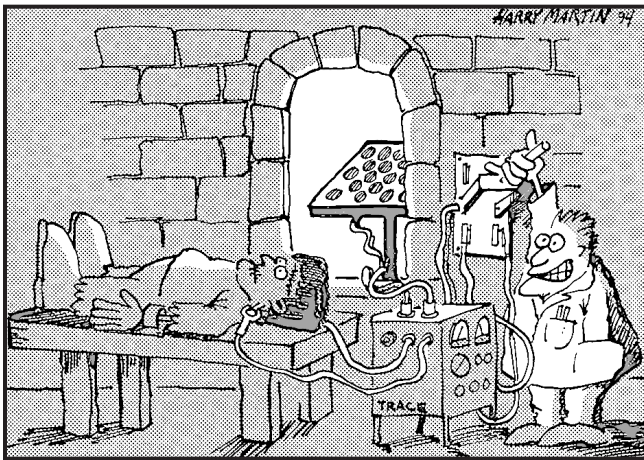
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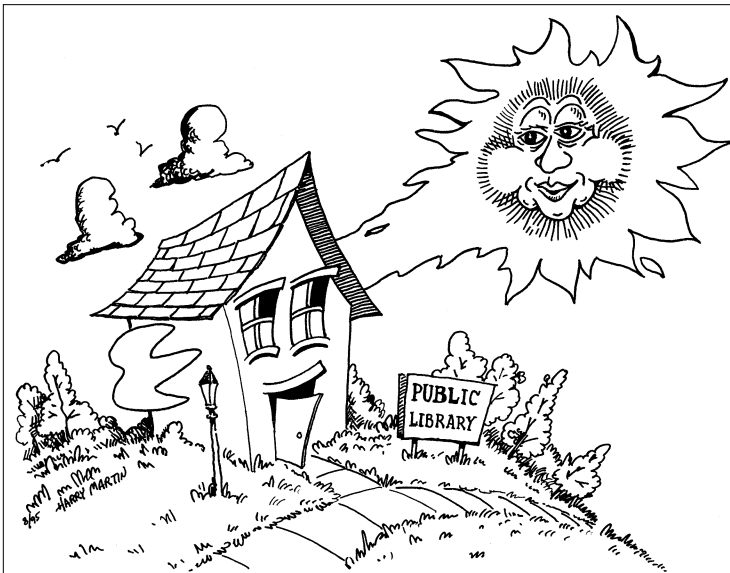
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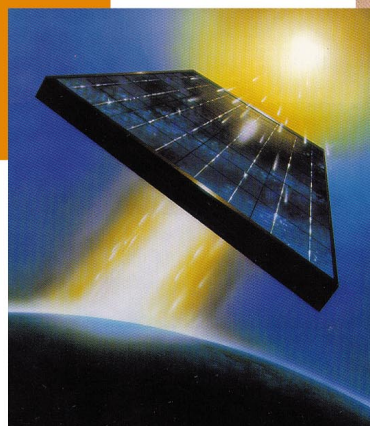
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